THE UNIVERSITY OF KANSAS
SCIENCE BULLETIN

VOL. XLVIII PAGES 325-524 AUGUST 22, 1969 NO. 13

A Comparative Morphological Study and Generic Revision of the Augochlorine Bees (Hymenoptera: Halictidae)[1]

GEORGE C. EICKWORT[2]

ABSTRACT

Bees of the subfamily Halictinae have recently come to the attention of biologists because of the intricacies of their nest structures and the gradation from solitary to social behavior found within the group, but study in the Neotropical region has been hampered by the lack of an adequate supraspecific systematic framework. The purpose of this study is to revise the Augochlorini to the generic and subgeneric levels. The Augochlorini is an American tribe of commonly bright green bees, forming the bulk of the Neotropical halictine fauna. To provide a basis for comparison for the augochlorine genera, a study of the external morphology of *Pseudaugochloropsis graminea* (Fabricius) was undertaken, using dried material and specimens preserved in fluid. Exemplar species representing the major augochlorine genera were then compared with *Pseudaugochloropsis* as to externally visible characteristics, and 49 characters were chosen as useful to distinguish genera. Species representing a wide range of variation within each known augochlorine genus were then compared with the exemplars as to these characters to provide the bases of the generic and subgeneric descriptions, each genus or subgenus thereby becoming an operational taxonomic unit. A numerical analysis was undertaken to aid in estimating overall phenetic affinities of the genera and subgenera. Character states were coded from the generic and subgeneric descriptions, and the data were clustered by the unweighted pair-group method of arithmetic averages; both correlation and distance matrices and phenograms are presented. Twenty-four genera and seven subgenera are recognized in the Augochlorini. *Corynurella* and *Andinaugochlora* are described as new genera, and *Neocorynura (Neocorynuroides), Augochlora (Oxystoglossella), Augochlora (Mycterochlora), Caenaugochlora (Ctenaugochlora)* and *Megommation (Megaloptina)* are described as new subgenera. *Callochlora* Moure is reduced from

[1] Contribution No. 1426 from the Department of Entomology, The University of Kansas, Lawrence, Kansas.

[2] Present address: Department of Entomology and Limnology, Cornell University, Ithaca, New York 14850.

generic rank to a subgenus of *Corynura,* and *Paraugochloropsis* Schrottky is removed from synonymy to become a subgenus of *Augochloropsis. Corynuroides* Sandhouse, *Micraugochlora* Schrottky, *Rivalisia* Strand and *Temnosomula* Ogloblin are placed in synonymy. A key to the genera and subgenera is presented. *Corynurella mourei* and *Andinaugochlora micheneri* are described as new species, and *Augochloropsis (Paraugochloropsis) metallica* (Strand) is proposed as a new combination for *Rivalisia metallica* Strand, and a lectotype of the latter species was chosen. Seven more-or-less well-defined generic groups centered around *Corynura, Rhinocorynura, Neocorynura, Augochloropsis, Augochlora, Pseudaugochloropsis,* and *Megaloptidia* were recognized according to phenetic and probable cladistic relationships, and include all genera except *Thectochlora, Megalopta, Chlerogella,* and *Temnosoma.* A phylogenetic scheme is proposed wherein the *Corynura* group is the most primitive, and *Augochloropsis, Augochlora, Megalopta* and the *Megaloptidia* group, and *Temnosoma* represent end-points of evolutionary lines.

INTRODUCTION

This study provides a classification at the generic and subgeneric levels of the Augochlorini, an American tribe of commonly bright green halictine bees. The Augochlorini are distinguished from other American Halictinae principally by the absence of a pygidial plate and ventrally visible surface of metasomal tergum VII and the presence of a spiculum on sternum VIII of the males, and the presence of a median slit on the pseudopygidial area of tergum V of the females. The tribe will be more completely characterized in a companion paper (Eickwort, in preparation).

Bees of the subfamily Halictinae have recently come to the attention of biologists because of the discovery of the intricacies of their nest structures and the behavioral patterns involved in their construction, and because of the gradation from solitary to social behavior found in the group. The Neotropical halictines have been studied biologically principally by Dr. C. D. Michener and his associates, and these bees have contributed important data leading to theories of the origin of social behavior and evolutionary trends in nest structure. The comparative structure of nests of Halictinae has been exhaustively reviewed by Sakagami and Michener (1962), who separated the predominantly Neotropical genera and gave references to publications concerning their nesting biology. It is apparent from this review that the genera have been in need of revision, in order to permit correct placement of species studied biologically and to ascertain whether relationships suggested by nest structure are also evident in the morphological structure of the adult bees.

The bright green halictine bees represent two separate lineages; the majority of the genera, related to *Augochlora,* which I am calling the Augochlorini (characterized briefly above and in greater detail in a companion paper); and a smaller number of genera related to *Agapostemon* and *Caenohalictus,* more similar to the cosmopolitan *Halictus-Lasioglossum* com-

plex. The *Agapostemon* group is still under study and is excluded from the present paper. The separate status of the Augochlorini was recognized by Vachal (1911), who called the group the *Halicti hexagoni,* but his grouping has not been recognized by subsequent authors.

Augochlorine bees are known only from the New World and are the most abundant Neotropical halictines, some representatives ranging outside the tropics to Canada and Chile. Many species are brilliant green in color, which accounts for the common name of "green bees," although other species are dull metallic greenish or black.

To provide a basis for comparison for the augochlorine genera, a study of the external morphology of one species, *Pseudaugochloropsis graminea* (Fabricius), is presented. Thereafter other forms are dealt with, often by comparison with *Pseudaugochloropsis.*

A report on the relationships of morphology to nest structure and social behavior is postponed, so that the non-augochlorine halictine genera can first be adequately studied.

ACKNOWLEDGMENTS

I am sincerely grateful to Dr. Charles D. Michener of The University of Kansas who has guided this study from shortly after its conception, provided encouragement and aid throughout and painstakingly read the manuscript. I also am indebted to Dr. George W. Byers of The University of Kansas for his guidance during Dr. Michener's absence and his similarly useful critical reading of the manuscript.

I am indebted to Padre J. S. Moure of the University of Paraná, Curitiba, Brazil, for enlightening discussions concerning South American Halictinae which provided me with a foundation on which to base this study. He also graciously identified and provided specimens of rare genera of bees, without which this study would have been quite incomplete. I also thank Dr. Donald E. Johnston of The Ohio State University for aid in morphological interpretation and Dr. Roland L. Fischer of Michigan State University for guidance in the initial phases of this study.

Thanks are extended to the following collectors and museum curators who have generously lent material: P. Alayo D., Academia de Ciencias de Cuba, La Habana; the late R. R. Dreisbach, Midland, Michigan; R. L. Fischer, Michigan State University, East Lansing; R. C. Froeschner, U.S. National Museum, Washington, D.C.; the late H. J. Grant, Jr., Academy of Natural Sciences of Philadelphia, Pennsylvania; P. D. Hurd, Jr., University of California, Berkeley; J. Oehlke, Deutsches Entomologisches Institüt, Eberswalde, East Germany; L. L. Pechuman, Cornell University, Ithaca, New York; R. B. Roberts, Oregon State University, Corvallis; J. G. Rozen, Jr., American Museum of Natural History, New York; R. R. Snelling, Los Angeles County Museum, Los Angeles, California; G. I. Stage, California Academy of Sciences, San Francisco; H. K. Townes, Ann Arbor, Michigan; G. E. Wallace, Carnegie Museum, Pittsburgh, Pennsylvania;

and R. Wenzel, Chicago Natural History Museum, Illinois. Special thanks are due to Drs. Froeschner and Rozen for the courtesies extended to me while I visited their museums to compare specimens.

I am deeply grateful to my wife, Kathleen, who proofread the manuscript and typed the first draft, assisted in the preparation and interpretation of the numerical analysis, and provided unfailing moral support. Mrs. Joetta Weaver and Miss Barbara Bond typed the final draft.

I acknowledge the financial support of the National Science Foundation, under whose graduate fellowships much of this research was conducted. One year of research and study was supported by a Danforth graduate fellowship, and I also gratefully acknowledge a grant from the Danforth Foundation which financed the final preparation of this manuscript. The assembling and preparation of specimens and other materials at The University of Kansas was largely through National Science Foundation grant GB91 (C. D. Michener).

HISTORICAL REVIEW

The following review deals only with major works concerning the generic classification of Latin American Augochlorini. The systematic history of individual genera is discussed with the description of each genus. This review will not deal with most works on Augochlorini of North America north of Mexico, as these can be easily found through the catalog of North American Hymenoptera (Michener, 1951) and its supplements (Krombein, 1958, 1967).

Fabricius described the first augochlorine bee as *Andrena metallica* in 1793 and later (1804) placed it and two new species in *Megilla.* The first important study of South American Halictinae was by Spinola (1851) on the fauna of Chile, which included his new genus *Corynura,* the first augochlorine genus described.

The groundwork for study of augochlorine bees was laid by Smith (1853) in his catalog of Hymenoptera in the British Museum. Erecting four new genera, he placed 34 species, mostly new, in *Augochlora* (30), *Oxystoglossa* (1), *Megalopta* (2), and *Temnosoma* (1). Other American halictines were placed in *Halictus, Sphecodes,* and *Agapostemon.* He based his new genera principally on wing venation and mouthparts which he illustrated for these genera. In 1879 he published further descriptions of bees in the British Museum, naming species in *Temnosoma, Augochlora, Megalopta,* and *Cacosoma.*

Ashmead, in his classification of the bees (1899), placed *Corynura, Augochlora,* and *Megalopta* (as *Megaloptera*) in the Halictinae, while *Temnosoma* was placed in the Sphecodinae. He placed great weight on wing venation, separating the Panurgidae from the Andrenidae on the basis of the number of submarginal cells. Since the number of cells is variable within

one species or even between wings of one individual in many halictine bees, this artificial subdivision greatly confused later generic descriptions within the Halictinae, although fortunately little affecting the Augochlorini.

The period from about 1890 to 1930 saw great activity in the naming of species of Neotropical Halictinae. Eight authors were especially noteworthy for their contributions: Alfken, Cockerell, Ducke, Friese, Herbst, Schrottky, Strand, and Vachal.

Vachal (1903-1904a,b, 1911) made the first significant attempt at classification of the American halictine fauna. In key form with short diagnoses, he described an immense number of species, all placed in the genus *Halictus*. In 1911 (pp. 9-14), he set forth the divisions and subdivisions of *Halictus* as he used it. He divided *Halictus*, which correspond to the subfamily Halictinae (plus *Sphecodes*) of today, into three divisions, the *Halicti genuini*, *Halicti intermedii*, and *Halicti hexagoni*.

Of these, only the *Halicti genuini* are also found in the Old World; the division coincided with the *Halictus-Lasioglossum* complex and related genera. He described the American species of this division in a different journal (1904b).

The *Halicti intermedii* included *Agapostemon* and its relatives. Vachal divided them into three groups, *Agapostemon*, *Pseudagapostemon*, and his new *Paragapostemon*. Vachal also included the *Halicti rhopali* as a small subdivision of the *H. intermedii*, coinciding with *Rhopalictus*. This subdivision included species currently placed in *Corynura* as well as relatives of *Agapostemon*.

He named his third group *Halicti hexagoni* because of the hexagonal appearance of the faces of the bees, caused by the deeply indented inner orbits of the eyes. This division, corresponding to my concept of the Augochlorini, was distinguished by Vachal as follows: "Orbite interne très fortement sinuée, ou même échancrée; par suite, les yeux sont réniformes et la face paraît hexagone. Yeux très rarement velus (les ex. à yeux velus peuvent-ils être rattachés aux *H. intermedii*?) Face tout au plus duveteuse. Les ♀ ont souvent l'éperon postérieur interne mutique, ayant tout au plus vers la base une dilatation anguleuse comme le talon d'une faux (*H. falcati*) . . . . *H. hexagoni*."

The *Halicti hexagoni* consisted of five subdivisions, the *Halicti megalopti*, *H. coarctati*, *H. vibrissati*, *H. sericei*, and *H. falcati*. The *Halicti megalopti* coincided with *Megalopta* and were characterized by enlarged ocelli and eyes. The *H. coarctati* were characterized by a constriction of the base of the metasoma and end of the mesosoma, and here Vachal included *Cacosoma* (=*Neocorynura*) and *Corynura*. The *H. vibrissati* coincided with *Augochlora* (actually, *Augochloropsis*) and were named for the apical fringes of setae, or "vibrissae," on the metasomal terga.

Vachal defined the *Halicti sericei* and *falcati* on the basis of lack of metasomal vibrissae and the long glossa and equated them to *Oxystoglossa*. He separated *H. sericei* from *H. falcati* on the basis of the hind tibial spurs of the female, pectinate in *sericei,* not pectinate and with an enlarged basal angle in *falcati*. He did not consider this separation to be meaningful division of the *H. hexagoni,* since he could not separate the males. He likewise rejected Schrottky's *Odontochlora,* as the males could not be distinguished. Vachal's *Halicti falcati* largely coincided with *Augochlora* of today, his *H. sericei* with a number of other genera.

Strand (1910) published an outline of the Vachal system which he had received by personal communication from Vachal. Alfken (1926), apparently unaware of Vachal's paper (1911), published a summary in German of Vachal's system, communicated to him by Vachal. This summation, in key form and slightly expanded over Vachal's 1911 publication, is the most easily available and usable source of the system.

Schrottky lived in Paraguay, and his contributions centered on the bees of South America from Brazil southward. Of the workers of his period, Schrottky was the most prolific namer of genera, proposing ten generic and subgeneric names in the Augochlorini. Unfortunately, his generic concepts were poor; he named genera on very few, often insignificant, characters and he consequently split valid genera and artificially lumped others together.

In 1902, he published a monograph on the solitary bees of Brazil, giving keys and descriptions of the genera and species, and he placed all augochlorine species in five genera and subgenera: *Temnosoma, Corynura, Augochlora, Augochlora (Augochloropsis),* and *Megalopta*. Later, Schrottky was to recognize many more genera. Like most early workers, he used *Augochlora* to refer to bees currently placed in *Augochloropsis*. He named *Paraugochloropsis* for the *Halicti vibrissati* of Vachal and *Pseudaugochloropsis* for the *Halicti sericei*. He split his *Augochlora* into genera and subgenera on the basis of the number of teeth of the tibial spurs, naming the taxa *Paraugochloropsis, Tetrachlora* [replaced by *Augochloropsis* (Schrottky, 1910)], and *Paraugochlora* [a replacement name for *Augochloropsis* as used by Schrottky (1909b)]. Species currently placed in *Augochlora* were placed in his *Odontochlora* (with metasomal sternum I armed in the female) and in *Oxystoglossa,* an artificial group containing species currently placed in several genera. Schrottky (1910) named *Neocorynura* to replace *Cacosoma* Smith, preoccupied, and noted that it was distinct from *Corynura,* but he failed to give adequate separating characteristics. Schrottky also erected four other new monotypic genera and subgenera. He published a summary of his generic concepts (Schrottky, 1909b), which he slightly revised a year later (Schrottky, 1910).

Ducke lived in Brazil, and his studies concentrated on the bees of that country. In contrast to Schrottky, Ducke was conservative in his generic concepts. As summarized in his monograph of the South American bee genera, Ducke (1912) recognized only *Sphecodes, Halictus,* and *Megalopta* as valid halictine genera. *Temnosoma* was considered a synonym of *Sphecodes* and other Augochlorini were placed as species groups of *Halictus.* He believed that Vachal had done the best job of dividing American *Halictus* into natural species groups.

Herbst, a resident of Chile, collected and studied the bees of that country. He (1917) published a revision of the bees described by Spinola which included a summary of the lives and expeditions of the early collectors in Chile. In 1922 he published a discussion of the halictine species of Chile, following the revision of Friese (1916b) and placing all species in *Halictus.*

Friese worked with bees from throughout the world and compiled several regional studies and generic revisions. He published a revision of the Chilean Halictinae (1916b), based largely on material collected by Herbst, and placed all species in *Halictus,* since he thought it to be premature to attempt to split the genus. In an account of Costa Rican bees (1916a), he described 52 halictine species, mostly new, placing the augochlorine bees in *Augochlora, Corynura,* and *Neocorynura*; he added a few more species in two later addenda (1921, 1925). Friese (1924, 1926) published revisions of *Temnosoma* and *Megalopta.*

Alfken described a number of species of Augochlorini from South America, but his most important contribution (1926) was a revision of the Chilean *Corynura* and discussion of the genus, which included the summary of Vachal's system previously mentioned. Strand (1910) published an account of the bees of Paraguay which included a key to the genera of South American Halictinae. He essentially followed Schrottky, although he identified *Augochlora* with bees we recognize in that genus today and placed *Paraugochloropsis* and *Pseudaugochloropsis* as subgenera of *Augochloropsis,* not of *Augochlora.*

Cockerell's papers on Latin American bees spanned the period from 1896 to 1949, including at least 58 papers dealing wholly or in part with Halictinae. Unfortunately, most of his papers are descriptions and comparisons of limited faunas and seldom are important as revisional studies or clarifications of genera. Among Cockerell's more comprehensive works are two papers on Brazilian bees (1900, 1901) and two papers on the bees in the British Museum (1905a,b), with comments on Smith's and Vachal's species.

Sandhouse (1937) revised the genera and species of augochlorine bees then known to occur in the United States, naming the genus *Augochlorella* for four species and placing four other United States species in *Augochlora* and

Augochloropsis. Her work, the first modern revisional work on augochlorine bees, included some Mexican species and illustrations of genitalia.

From 1940 to the present, Padre J. S. Moure, C. M. F., of Brazil and Dr. C. D. Michener of Kansas and their associates have been the principal contributors to the systematic study of Latin American halictines.

Moure has published at least 23 papers concerning halictines, mostly dealing with the Brazilian fauna. He has clarified and redescribed the augochlorine genera named by earlier workers, especially the artificial groups created by Schrottky; he has also described a large number of new genera. Moure has largely recognized natural groupings, in my opinion, although some of his genera are split rather finely and are considered subgenera or species groups in this paper.

In an important paper, Moure (1943) named the tribe Augochlorini, with type genus *Augochlora*. He equated the Augochlorini with Vachal's *Halicti falcati* and characterized it as having coloration generally metallic, at least in part; the eyes glabrous, deeply emarginate superiorly; pleuro-metaphragmal carinae very short and divergent; marginal depressions little depressed and without vibrissae; internal posterior spur simple.

In the same paper, Moure erected the tribe Augochloropsini, type genus *Augochloropsis*, and equated it with Vachal's *Halicti vibrissati*. He characterized the tribe as having the posterior spur pectinate; males with the 4th sternite provided on each side with a long ciliate appendage; pleuro-metaphragmal carinae parallel or almost parallel; marginal borders of tergites 1-2 generally vibrissate.

Moure presented a key to the South American genera which he placed in the Augochlorini, including *Augochlora, Oxystoglossa, Rhopalictus, Paroxystoglossa, Pereirapis, Ceratalictus,* and *Oxystoglossidia*. This key was later revised (Moure, 1950), substituting *Corynura* for *Rhopalictus, Augochlorella* for *Oxystoglossidia,* and elminating *Oxystoglossa*. Moure's Augochlorini, except for *Corynura,* coincides with a generic group clustered around *Augochlora* in my system, discussed later in this paper; the tribe Augochlorini as used herein is much broader in scope. I consider the Augochloropsini to be included within the Augochlorini.

In the same paper, Moure named the subfamily Megaloptinae for the *Halicti megalopti* of Vachal, characterized by the great development of the eyes and ocelli, and the tribe Megaloptini, type genus *Megalopta* for species with normal maxillary palpi. He included in the Megaloptini the genera *Megalopta, Megaloptidia, Megaloptella, Megommation* and *Tmetocoelia*. Moure stated that he would later name a second tribe for a new genus with elongated maxillary palpi. In later papers, Moure (1951, 1958b) called the new genus with elongated palpi *Ariphanarthra,* but did not create a separate tribe for it, and synonymized *Tmetocoelia* and *Megaloptella* with *Megalopta*.

Moure's Megaloptini is also included within the Augochlorini as used herein, representing a generic group clustered around *Megaloptidia* plus *Megalopta* (see discussion section of this paper).

Among Moure's more important recent papers on Halictinae have been a redescription and generic reassignment of Smith's species of *Megalopta* (Moure, 1958b) and a specific revision of *Paroxystoglossa* (Moure, 1960a). *Paroxystoglossa* remains the only Latin American augochlorine genus of more than two species for which there is an adequate revision. Moure (1964) has recently provided a key to the genera and subgenera of Chilean Halictinae, two of which, *Callochlora* and *Corynura,* are augochlorines.

Michener (1944) placed the augochlorine genera in the Halictinae in his classification of the bees, not giving them separate status.

Michener (1951) in the Hymenoptera catalog listed the North American species of Halictinae and their synonyms, largely following the generic arrangement of Sandhouse (1937). In supplements to the Hymenoptera catalog, Krombein (1958, 1967) followed the generic changes and synonyms given by Michener (1954) and, for eastern North American species, by Mitchell (1960).

In an important revision of the bees of Panamá, Michener (1954) provided a key to the genera and species of Halictinae known from that country, and described many new species and illustrated male genitalia.

Ordway (1966) has recently revised the North American species of *Augochlorella,* including Mexican species not in *Pereirapis.* She presented a key to the genera of green halictines of the United States, including *Augochlora, Augochlorella, Augochloropsis, Agapostemon, Pseudaugochloropsis,* and *Temnosoma.*

Mitchell (1960), in his revision of the species of bees of the Eastern United States, used the generic system of Michener (1954) for augochlorine bees. His work is especially notable for the consistent use and illustration of male genitalia and sterna.

METHODS

External morphology of Pseudaugochloropsis graminea. Both dry pinned museum specimens and material fixed in the field with Dietrich's (Kahle's) solution and preserved in 80% ethanol were used in this study. Illustrations and descriptions were based primarily on dry material, so as to be applicable to other genera for which only dry specimens were available. However, specimens in liquid were compared with dry material for all parts, especially the mouthparts and terminalia.

Dry specimens were relaxed in a moist chamber and the parts to be studied were removed under a dissecting microscope and either glued to cardboard dry or placed in a vial of potassium hydroxide (KOH). The vial was placed in boiling water, and the bee parts when properly cleared were transferred to 35% acid ethanol and then either preserved in glycerin or run through an alcohol series and mounted on a slide in diaphane. All parts which could be studied flattened were mounted in diaphane as permanent slides, for study under a phase microscope or to be drawn with the aid of a microprojector. Material in liquid was dissected in alcohol and the parts examined in alcohol or glycerin.

Illustrations of the following parts were drawn from microprojections of slide-mounted material: antenna, labrum, epipharynx, hypopharyngeal suspensorium, parts of the proboscis, tegula, wings and their basal sclerites, legs (excluding coxae) and associated structures, metasomal sterna, male metasomal tergum VIII plus proctiger, sting and associated spiracle plates, and volsella of the male genitalia. The microprojections were supplemented by phase-contrast observations of the slide preparations and by comparisons with cleared parts in glycerin, parts in alcohol, and dry material.

Special preparatory techniques were necessary for adequate observation of some parts. The mouthparts were removed from a relaxed bee by extending the proboscis from the fossa with the aid of a bent minuten nadel, grasping the base of the labio-maxillary tube with forceps and gently pulling the proboscis loose from the head. The distal parts of the maxillae and prementum were separated from the labio-maxillary tube by grasping the distal parts just distad of the anterior conjunctival thickenings with one pair of forceps while grasping the labio-maxillary tube with another forceps, and gently separating the thickenings from their distal connections. The labio-maxillary tube was slit with a minuten nadel along its membranous lateral areas and the anterior and posterior conjunctival thickenings were mounted separately. The distal parts of the maxillae and prementum were separated basally, and the former were mounted with palpi extended. The prementum was held basally, anterior surface upwards, with one minuten nadel while the blunt edge of a second bent nadel was used to gently pull the glossa to its full extended length. One palpus was removed to expose the paraglossa before the labium was mounted.

The terminal segments of the metasoma were examined by removing the entire metasoma behind segment III, clearing in KOH, and separating the sterna and terga prior to mounting. The sterna were mostly flattened in slide preparations, consequently the dorso-lateral areas do not appear to be bent upwards in the illustrations. However, sternum VI of the female was not flattened on a slide. Sterna VII and VIII of the male were usually dissected as a fused unit. They can be separated only with difficulty by manipulating a minuten nadel between the two sterna, and consequently are illustrated for *Pseudaugochloropsis* and most other genera both as a fused unit and as separate sclerites.

Metasomal tergum VIII plus the proctiger of the male was usually found closely appressed to the inner surface of tergum VII, attached to the gut. With care, the structure could be pulled loose from tergum VII with minuten nadeln. The anal lip of the proctiger is usually folded within the proctiger; it was extended by using the method described in the account of the morphology of *Pseudaugochloropsis*.

The sting was normally dissected as a unit within metasomal sternum VI. The spiracle plates were dissected away from the sting, their connecting membrane severed and they were mounted separately on a slide. The membrane dorso-caudally connecting the two halves of the remainder of the sting was severed so that the sting could be flattened on a slide. For more detailed observations, the shaft was removed from its associated plates.

After examination of the intact male genitalia, they were separated by removing the gonobase, penis valves, and volsellae, and the gonostyli were mounted on a slide for phase-contrast observation. After drawings had been made of the lateral view of the dissected penis valve, the valves and volsellae were also slide-mounted for more detailed observation. Clearing the genitalia in KOH so distorted the penis itself that it was not studied critically.

Illustrations not prepared from microprojections were drawn by observing parts under a dissecting microscope. Drawings were made with the aid of an optical grid; details were added by observation of slide mounts with a phase microscope.

Comparative morphology of the augochlorine genera. Specimens illustrating the range of variation in each named genus as exemplified by obvious external characters were selected from The University of Kansas Snow Entomological Museum and the Michigan State University Entomology Museum collections, with additional material selected from the other collections listed in the acknowledgments. Most of the material was unidentified, although material named to species was consulted where available. When possible, an adequate series of males and females of each species was obtained to provide sufficient material for dissection and detection of intraspecific variation. Thanks largely to the identified material provided to The University of Kansas by Padre J. S. Moure, species of all previously named augochlorine genera were available.

From the species exhibiting the range of variation of each genus, one species was selected as an *exemplar* of the genus on the following bases: availability of a large sample of both sexes; characteristics representative of most species in the genus; species characteristics sufficiently distinctive to insure a conspecific sample; large size for ease of manipulation; specimens belonging to The University of Kansas or Michigan State University, or otherwise accompanied by permission to dissect; and ability to name the species. Since adequate revisions exist for very few of the genera, and since I have not had the opportunity to examine types of most species of augochlorine bees, names could not be applied with certainty to all of the selected species. In large genera with considerable variation, two or three exemplars were chosen. The preliminary selection of species for study led me to select some species as representing new genera and to include these among the exemplars. In small genera with few specimens available, the exemplars could not fulfill all the criteria above, and at times consisted of one specimen.

When material was available, numerous specimens of both sexes of each exemplar species were dissected and the parts mounted in diaphane as permanent slides, as described for *Pseudaugochloropsis graminea*. Nearly every character described for *Pseudaugochloropsis* was compared with that character in each exemplar, and the differences noted. Among the few structures not compared were the epipharynx, the cervix, the hidden portions of the prepectus and second coxa, the ventral region of the mesosoma, and the basal sclerites of the wings, all due to their relative difficulty of preparation. Spot checks of some genera suggested that these structures were not particularly useful taxonomically.

Characters of the exemplar species that differed significantly from those of *Pseudaugochloropsis graminea* were drawn in the same fashion as for *Pseudaugochloropsis*. As nearly as possible, the same parts of different species were all drawn to the same size in the illustrations; thus drawings of each species are likely to be to a different scale. Since there are often large differences in size among species within a genus, size was judged not to be of paramount importance, and illustrating parts so they appear to be of the same size emphasizes differences in proportions which often are important.

Several characters are so important in generic classification that they are illustrated for all or nearly all generic exemplars. These are the hidden male metasomal sterna, the male genitalia, and the face of the female. In contrast, some characters are surprisingly invariable, most noteworthy being the sting apparatus.

As described in the section on characters employed, the exemplar study permitted selection of characters which appeared particularly useful to separate genera. These characters were then examined in each of the species initially selected to represent the range of variation of each genus. Mouthparts were dissected from females and metasomal segments behind segment III were dissected from both sexes, and the parts cleared and studied in glycerin. Temporary glycerin mounts were made of the mouthparts and hidden male metasomal sterna for study under the phase microscope.

This comparative study provided some knowledge of the range of variation in each genus, and led to the recognition of new genera and subgenera which were not originally apparent by their general appearance. While type species were not necessarily used as exemplars, they or species closely resembling them were examined in the comparative study for nearly all genera.

All measurements were made with a Filar optical micrometer mounted upon a dissecting microscope and were based upon dry museum specimens except for the measurements of the mouthparts, which were based upon slide preparations. All measurements are expressed as ratios to eliminate the general size factor.

During the comparative study, a number of unique specimens representing unnamed genera were discovered. However, the description of these genera is not undertaken at the present time. I prefer to wait until further collecting can provide more specimens and both sexes.

Similarly, in some of the large genera a number of individuals exhibited variation that might justify subgeneric status. Usually sexes could not be positively associated, and named species were not involved, to my knowledge. In these cases, naming of subgenera has been

postponed until more specimens confirm their validity, although exceptions to the generic descriptions that these specimens present are noted.

Only those species are described that are necessary to serve as types of new genera and subgenera. Some of these new species may be synonyms of previously named species which I cannot recognize because of inadequate original descriptions. Moure has examined the types of most previously named species and is preparing a catalogue which will give their correct generic positions; species are therefore not listed herein.

The generic descriptions take into account all characters described in the "characters employed" section and follow the same numbering system. When a character is "normal" as described in the section on characters employed, mention of it is usually omitted in the generic descriptions. Thus any numbers missing in a generic description can be assumed to refer to characters which have "normal" states. The particularly important characteristics of each genus and subgenus are italicized. Major trends of variation are noted in the descriptions. Where one or a small group of species differs from the majority in a character or characters, these are listed below the generic descriptions in a separate section as "exceptions." Characters discussed in such sections are marked by asterisks in the generic descriptions.

Generic interrelationships and numerical analysis. The inter-relationships of the genera are not discussed in detail with the generic descriptions, but are considered in a section entitled "Discussion." To aid in the analysis of phenetic similarities, a numerical study was conducted, using the features listed under "Characters Employed." This numerical analysis largely follows the ideas and terminology used by Sokal and Sneath (1963).

The character states were coded from the descriptions of each genus and subgenus, as listed in Table 1 in Appendix 3. Thus each operational taxonomic unit, or "OTU," is a genus or subgenus, and the character states are coded to take into account the range of variation present within the genera and subgenera recognized in this study. This is in contrast to most previous studies, including those of the *Hoplitis* complex of bees (see recent papers by Michener and Sokal, 1966, and Sokal and Michener, 1967), which have used individual specimens or species as OTU's. By using the entire genus or subgenus as the OTU, a certain amount of objectivity has been lost, as there is no opportunity to test if the species placed within a genus are artificially so grouped. One possible alternative, to use every species that differed in any way in any character used, would introduce a prohibitive number of OTU's. Another alternative, to select only one species within each genus or subgenus as an exemplar and use it as the OTU, hides the variation present within many genera. The latter alternative would prove an interesting check on the system I have used, however.

The data matrix was analyzed on the GE 625 computer at The University of Kansas Computation Center, using the "NT-SYS" system developed by Dr. F. James Rohlf, John Kishpaugh, and Ronald Bartcher of The University of Kansas. The program used ("CLST") standardized the data, computed distance and correlation matrices, clustered the OTU's by the unweighted pair-groups method of arithmetic averages, generated distance and correlation phenograms, computed cophenetic value matrices for the two phenograms, and compared the distance and correlation matrices with their cophenetic value matrices. The distance and correlation matrices from this program are included in Appendix 3; the phenograms are redrawn in Figures 417 and 418.

The effects of using different clustering techniques on the same data have been discussed by Sokal and Michener (1967). A similar analysis of many different systems was beyond the scope of this study; the differences between the results based on clustering distances or correlations are noted in the discussion section. Michener and Sokal (1966) have found that stressing one sex or one tagma of a bee can change the results of a numerical analysis; I have attempted to weight both sexes and all tagmata equally (in numbers of characters) so as to minimize this effect.

The results of the numerical analysis are compared with my intuitive concepts of what constitutes "natural" groupings of genera in the discussion section. A high value in the correlation matrix and a low value in the distance matrix both indicate a high degree of similarity between two OTU's.

EXTERNAL MORPHOLOGY OF *PSEUDAUGOCHLOROPSIS GRAMINEA*

The only halictine bee whose external morphology has been studied in detail is *Halictus farinosus* Smith, a North American species not in the Augochlorini. Michener (1944) compared this species, a species of *Sphecodes,* and many non-halictine bees to *Anthophora edwardsii* Cresson.

The present study of *Pseudaugochloropsis graminea* (Fabricius) was undertaken to provide a descriptive basis for comparative morphological studies of augochlorine bees. Its principal concern is the external skeletal anatomy as can be examined conveniently in dried specimens, and it does not purport to advance new evidence as to the evolutionary origin of structures. Terminology and interpretations largely follow that applied by Michener (1944) for *Anthophora edwardsii* and Snodgrass (1956) for *Apis mellifera,* the honey bee. A recent detailed study of the external morphology of a stingless bee, *Melipona marginata,* by Camargo, Kerr, and Lopes (1967), was seen too late for its terminology to be used extensively in this study, although a few new terms introduced by Camargo *et al.* are used for *Pseudaugochloropsis.*

Pseudaugochloropsis graminea was selected as the basis for comparison because: (1) it has the widest range of any augochlorine bee; it or close relatives occur from southern Texas to Argentina, including the West Indies, and are well represented in collections; (2) aspects of its biology are known (Michener and Kerfoot, 1967; Sakagami and Moure, 1967); (3) aspects of its internal morphology have been examined by Brazilian workers (for example, da Cruz Landim, 1967; Urban, 1963); (4) it is comparatively large and easily handled; (5) large numbers of specimens (pinned and preserved in fluid) were available for study; and (6) its taxonomic status was recently clarified by Moure (1960b), who also presented a bibliography for the species. Since that date, Eickwort (1967) has recognized a closely related species in Costa Rica.

In general appearance, *Pseudaugochloropsis graminea* is a brilliant green bee with plumose pubescence that usually does not obscure the body surface. The species is about 9 mm. long. Punctation, color, and general body pubescence are not discussed below.

Several terms used throughout the description merit clarification. General body pubescence is sometimes referred to as "hair" since the hair bases were seldom examined as to articulation; most hairs are probably setae. Short simple setae that occur in well defined groups are often referred to as "sensory setae"; these are frequently found in situations analogous to those described by Lindauer and Nedel (1959) and Markl (1962) for *Apis* and probably function as propioreceptors. Small cuticular rings that resemble pores and do not contain noticeable setae are referred to as "pore-like sensilla."

Female

Head. The head (Figs. 1-4) is slightly wider than long and suborbicular in frontal view and somewhat triangular in profile. The face above the antennal sockets and below the lower margin of the median ocellus may be divided by imaginary vertical lines running dorsally from the outer edges of the antennal sockets into a slightly swollen median *frons* (Fr) (supra-antennal area of Michener, 1944) and lateral *parocular areas* (Pao). The top of the head, or *vertex* (Vx), is continuous with the face and produced into a rounded elevation posterior to the lateral ocelli.

The *clypeus* (Clp) is delimited by an epistomal sulcus which runs between the *anterior mandibular articulations* (amd). The clypeus is slightly convex in profile, the lateral portions curved posteriorly. The *marginal area* (mCl) of the clypeus is depressed, bears a row of long strong setae, and is bounded laterally by produced *clypeal teeth* (toCl).

The epistomal sulcus (interpretation of Bigelow, 1954) is composed of five parts: the horizontal *fronto-clypeal sulcus* (fcs), from which two *dorsal clypeo-genal sulci* (dcgs) extend downward to the elongate *anterior tentorial pits* (atp), and the weak *lateral clypeo-genal sulci* (lcgs) extend from the pits to the anterior mandibular articulations, forming rounded *epistomal lobes* (Esl) of the parocular areas with the dorsal clypeo-genal sulci.

The *subantennal sulci* (sas) (outer subantennal sutures of Michener, 1944) extend from the ventral margins of the antennal sockets to the junctions of the fronto-clypeal and dorsal clypeo-genal sulci, and bound the *supraclypeal area* (Sucl), limited dorsally by a deep dorsally arched impression between the upper edges of the antennal sockets. The supraclypeal area is strongly protuberant, more so than the clypeus, and is rather sharply beveled. The supraclypeal area medially bears the raised *frontal line* (frl) which extends onto the frons. The parocular areas (genae of Snodgrass, 1956) extend ventrally to the clypeus and are bordered medially by the epistomal and subantennal sulci.

The above terminology does not exactly agree with the morphological interpretations of DuPorte and Bigelow (1953) and Bigelow (1954). The frons is considered by them to also include the upper parocular areas and the supraclypeal area, and that usage is followed by Snodgrass (1956) for *Apis*. The subdivisions listed above are taxonomically useful, however. The subantennal sulci are interpreted by them as fronto-genal sutures, and the lower parocular areas as genae. The anterior tentorial pit is interpreted by DuPorte and Bigelow as retaining its position at the junction of the fronto-genal and fronto-clypeal sutures, but in *Pseudaugochloropsis* it is located far ventral to the fronto-clypeal sulcus. Perhaps the dorsal clypeo-genal sulcus represents a fusion of the fronto-genal and fronto-clypeal sutures.

A narrow sclerotized area runs between the anterior and posterior man-

dibular articulations below the eye, the *malar area* (Mal) (gena of Snodgrass, 1956). In lateral view, the *genal areas* (Ge) (postgenae of Snodgrass, 1956) comprise the head behind the eyes and are about as wide as the eyes at their maxima. The genal areas and vertex extend posteriorly to a rounded *preoccipital ridge* (Pror) which surrounds a central strongly depressed area, the *occiput* (Oc). The *occipital foramen* (For) (foramen magnum of Michener, 1944) connects with the cervix, and the *tentorial bridge* (TB) can be seen within. Surrounding the occipital foramen is the *postocciput* (Poc), which is delimited by the *postoccipital sulcus* (pos), containing the *posterior tentorial pits* (ptp). Below and between the tentorial pits, the postocciput forms the *postoccipital bridge* (Pobr) which bears two *setal plates* (sp) which appear homologous to those described by Markl (1962) for *Apis*. Extending ventrally from the base of the postoccipital bridge is a Y-shaped *postgenal suture* (pges) which marks the junction of the *postgenal lobes* (Pgel) to form the *postgenal bridge* (Snodgrass, 1960).

Ventrally the genal areas are extended as *postgenae* (Pge) (Snodgrass, 1960) to the deeply impressed *proboscidial fossa*. The fossa is bordered by *hypostomal carinae* (hsc), which extend medially from the *posterior mandibular articulations* (pmd) to rounded *anterior angles* (ahsc) of the carinae, then posteriorly bordering the fossa to a *posterior flange* (flhs) which surpasses the postgenae and marks the posterior end of the fossa. The posterior half of the fossa, bordered by the hypostomal carinae, has a sclerotized floor and walls and forms the *hypostoma* (Hst). The floor of the hypostoma is marked with the Y-shaped *hypostomal bridge suture* (hsbs); the median portion of the hypostoma between the arms of the "Y" is the *hypostomal bridge* (Hsb). The hypostomal bridge suture joins the postgenal suture. Extending forwards from the anterior angle of the hypostomal carina is the *paramandibular process* (Pamd) which reaches the clypeus and forms the medial border of the *mandibular socket* (MdS). Each paramandibular process is externally strengthened by a flattened carina.

Following the interpretation of Snodgrass (1960), the hypostoma (excluding the hypostomal bridge) could be considered part of the postgenae, continuous with them posteriorly. The hypostomal bridge suture would then be considered a continuation of the postgenal suture, and the hypostomal carinae would be considered secondary strengthening developments, coincident with the proboscidial fossa, as Michener (1944) suggested. The hypostomal bridge, which is lighter in color than the remainder of the hypostoma when viewed in cleared specimens with transmitted light, and the postoccipital bridge, which resembles the hypostomal bridge in transmitted light, could then both be considered remnants of the hypostomal bridge.

The *inner orbit* (ioE) or margin of the *compound eye* (Eye) is deeply emarginate above the level of the antennae. Each eye is clothed with fine

simple hair, about two to five times as long as the diameter of an ommatidium. In the honeybee, Neese (1965) demonstrated that the long eye hairs are sensilla trichodea and help control sidewind deviation during flight. If hairs are removed from only one eye of a worker honeybee, she deviates in the measurement of the sun's angle. Neese also recorded the families of insects in which eye hairs are present, but he did not mention the Halictidae.

The two lateral and one median *ocelli* (O) are arranged in a triangle on the vertex.

The *antennal sockets* are placed midway on the face. Each is surrounded by a narrowly elevated *antennal sclerite* (AnS) and the *antennifer* (af) can be seen within, projecting from the lower median edge, when the antenna is removed. The *antenna* (Fig. 6) is of 12 divisions, the first of which, the *scape* (Scp), comprises over one-third of the total length. The scape is constricted at its base to form a *basal bulb* (bSc) which articulates in the antennal socket. The second division, or *pedicel* (Pdc), is narrowed at its base where it articulates with the scape. The remainder of the divisions form the *flagellum* (Fl).

The scape is partially clothed with long plumose hairs. The basal bulb and the base of the pedicel bear fields of sensory setae comparable to those described by Markl (1962) for *Apis*. The apical portion of the pedicel contains longer simple setae. The terminal nine flagellomeres bear bands of sensory plates (sensilla placodea), with sensory setae intermingled, oriented parallel to the long axis of the flagellum. The flagellar surface is divided into two differently textured longitudinal bands. About 0.4 of the circumference of each flagellomere is occupied by larger, more conspicuous sensory plates, the remainder by smaller, closer, less conspicuous plates. The first flagellomere bears only setae, and the second, setae plus a few scattered plates. The apex of the distal flagellomere is beveled and bears intermingled curved and straight sensory setae. In *Apis,* the sensory plates are arranged in bands occupying about two-thirds the circumference of the distal eight flagellomeres (Richards, 1952). The structure of the apex of the flagellum and its function in cell building in *Apis* was discussed by Martin and Lindauer (1966).

Among the authors who have studied bee mouthparts (see Michener, 1944, for references), Demoll (1908) presented especially detailed illustrations, including European species of Halictinae. Smith (1853) more crudely illustrated mouthparts of four genera of Augochlorini. In the following account of *Pseudaugochloropsis,* "anterior" and "posterior" refer to the surfaces of the downward extended mouthparts.

The *labrum* (Lm) (Figs. 7-8) articulates with the clypeus between the clypeal teeth. Anteriorly the labral *basal area* (baLm) is elevated above the *distal process* (dpLm). The distal process laterally runs to the basal margin of the labrum, largely hidden by the lateral margins of the basal area. The

basal area medially bears a protuberant *basal elevation* (clLm), which bears pore-like sensilla. The distal process is flat and bears a thin median *distal keel* (keLm) which is perpendicular to the process, rounded, and merges with the process at its junction with the basal area. At its lateral margins the distal process bears a row of long flat setae, the *labral fimbria* (fiLm).

The *epipharynx* (Figs. 13-14) projects downwards from the inner wall of the clypeus. It is similar in size and outline to the labrum and lies immediately behind it. The soft white epipharynx is triangular in cross section, the anterior face being slightly concave with a short median longitudinal keel. The posterior swelling medially bears a thin rounded *posterior keel* (pkEp). The posterior swelling bears numerous pore-like sensilla.

The curved *mandibles* (Figs. 9-11) are articulated at the anterior and posterior mandibular articulations below the compound eyes. The *mandibular acetabulum* (acMd) articulates with the condyle at the anterior articulation, and the *mandibular condyle* (coMd) with the posterior articulation. Distal to the swollen basal region, the mandible is somewhat compressed and curved inwards. The mandible bears on its anterior edge a *subapical tooth* (toMd), separated from the remainder of the mandible by *inner anterior* (iaMd) and *outer anterior grooves* (agMd). An *outer diagonal ridge* (drMd) runs from the acetabulum towards the apex of the mandible. An *outer posterior groove* (pgMd) is bounded by an *outer posterior ridge* (prMd). Both the mandibular tip and the subapical tooth may be largely worn away. The mandible bears long hairs on the anterior, posterior, and outer surfaces of the basal region, and in the grooves. The anterior basal region also bears a patch of sensory setae near the acetabulum.

With the exception of the mandibles, the mouthparts are joined into a *proboscis* (Fig. 12) which can be folded into the proboscidial fossa. The basal portion of the proboscis, from its junction with the head to the bases of the prementum and galeae, forms a partly membranous *labio-maxillary tube* (LMT). A detailed analysis of the complicated structure of the proboscis is beyond the scope of this study.

The basal portions of the *hypopharynx* (Fig. 15) are interpreted following Snodgrass (1956). The thin lightly sclerotized *hypopharyngeal lobe* (hlo) is placed medially at the base of the labio-maxillary tube. It appears notched at its base and bifid at its apex, medially it is grooved. Its position and shape are such that the posterior surface of the epipharynx fits snugly into it, the posterior keel of the epipharynx resting in the median groove. Extending into the head from the base of the hypopharyngeal lobe is the *hypopharyngeal suspensorium* (HS), the base of which, the *hypopharyngeal plate* (hpl) (pharyngeal plate of Michener, 1944) bears pore-like sensilla. Extending upwards from the plate are a pair of *oral hypopharyngeal arms* (arm) (pharyngeal rods of Michener, 1944) (Fig. 16); the membrane connecting

these arms bears a poorly defined *median oral plate* (hop). The arms are sharply hooked at their apices.

The anterior portion of the labio-maxillary tube is composed of a complicated series of overlapping sclerites, the *anterior conjunctival thickenings* (ACon), considered a secondary development by Michener (1944). They are illustrated in Fig. 17 but will not be analyzed further. Apically they articulate with the prementum and stipites.

The posterior portion of the labio-maxillary tube (Fig. 18) is bordered by a pair of strong *cardines* (Cd) which basally articulate with the head above the articulations of the anterior conjunctival thickenings and distally articulate with the bases of the stipites. The area between the cardines is sclerotized for about three-quarters of its length from the apex; this sclerotized region was considered a secondary *posterior conjunctival thickening* (PCon) by Michener (1944). Its position and apical articulation with the prementum is analogous to that of a postmentum, and it was considered a submentum by Demoll (1908). Basally the posterior conjunctival thickening joins a membrane which connects with the anterior edge of the hypostomal bridge.

The *stipes* (St) is a long narrow sclerite forming the curved outer edge of the distal portion of the *maxilla* (Mx) (Figs. 19-21). The *galea* (Ga) joins the medial edge of the stipes for about 0.85 of its length and projects beyond it apically. The galea is a thin blade-like structure, convex posteriorly, and provided with an inner ridge. The pointed *postpalpar portion of the galea* comprises about one-quarter of the length of the galea. The outer edge of the galea is rounded and well sclerotized. An *inner strip* (isGa) connects the outer edge with the blade-like medial portion of the galea on its anterior face; it bears crowded thin setae, with a few short stout setae basally. The *maxillary palpus* (MxPlp) arises at the apex of the stipes on the lateral margin of the maxilla from a small membranous area. It is composed of six cylindrical segments, the first and last subequal in length and slightly longer than the other four.

The distal portion of the *labium* (La) (Figs. 22-27) is composed of the *prementum* (Prmt) and the *ligula*. The prementum is an elongate structure whose lateral margins are folded anteriorly and then medially to nearly meet in the midline of the anterior surface. The posterior surface is slightly convex with the median area abruptly more convex; the anterior surface is flattened. Posteriorly the prementum is trilobed apically, the median point joining the *subligular plate* (Sli). Rods inserted posteriorly meet the *ligular arms* (lia) which curve anteriorly to form the lateral margins of a triangular anterior plate, the *salivary plate* (Slp) ("hypopharynx" of Demoll, 1908). The apex of the salivary plate is V-shaped and laterally bears pore-like sensilla. A pair of conspicuous dark *anterior longitudinal braces* (alb) run parallel to and below the salivary plate and meet the ligular arms near their apices; they are

swollen basally and terminate at the level of the base of the salivary plate. The *salivarium* (Slv) opens in the membrane on the anterior side at the base of the salivary plate.

The ligula is composed of two paraglossae and an elongate median glossa. The *paraglossae* (Pgl) are thin, two-segmented structures arising anteriorly at the sides of the salivarium. The basal segment is darkly pigmented medially, and bears a row of strong setae at its base. The distal segment is membranous and narrow and clothed with long cuticular hair-like projections.

The *glossa* (Gls), when fully extended, is a narrow elongate structure comprising about 40% of the total length of the ligula plus prementum. Posteriorly a *median groove* (grGl) runs the length of the glossa, containing a transparent, hard, flexible glossal rod (*Zungenbeine* of Demoll, 1908). The glossal cuticular hairs are long and plumose, arranged in bands similar to those of *Apis* (Snodgrass, 1956), and are longer and fewer per row on the posterior surface, where they border the median groove. The tip of the glossa is pointed and unmodified. The glossa can be considerably contracted in length, and both the glossa and paraglossae can be partially retracted into the apex of the prementum in a manner similar to that of *Apis* (Snodgrass, 1956).

The *labial palpi* (LbPlp) arise laterally on the posterior surface just beyond the apex of the prementum. The first segment of the palpus is longer than the next two together and strongly flattened. The distal three segments are cylindrical.

The entire proboscis can be folded into the proboscidial fossa, with the labrum folding over the apical portions, in turn covered by the mandibles which cross over it. The tips of the galeae are folded back directly beneath the labrum. The posterior median area of the prementum and posterior edges of the stipites form the remainder of the exposed proboscis, with the palpi and tip of the glossa also exposed from beneath the labrum (Fig. 5).

Connecting the head with the thorax is a membranous *cervix* which contains a small, weakly sclerotized median ventral *cervical sclerite*.

Mesosoma. The second tagma of bees consists of the thorax plus the first abdominal segment and is called the *mesosoma* (Figs. 28-33), following Michener (1944). A recent paper by Daly (1964) has added greatly to our knowledge of the morphogenesis of the thorax of *Apis*. The interpretation of the hymenopteran thorax has been subject to controversy, especially concerning the ventral region (see Richards, 1956, and Daly, 1964, for reviews).

The *pronotum* is attached to the mesothorax; it is short dorsally but expanded laterally below the tegulae. The *dorsal surface* (dlN) of the pronotum is distinctly concave, seen in lateral view, shiny, and margined with a raised cream-colored *pronotal lip* (lNlp). At its anterior lateral corners, the pronotum is produced as obtuse *lateral angles* (laN) and continued laterally in nearly straight lines as carinate *dorsal ridges* (drN), which end on the

produced *pronotal lobes* (Lobe) (posterior lobes of the pronotum), covering the first thoracic spiracles. The dorsal surface of the pronotum is separated from the *lateral surfaces* (lsN) by sharply rounded *lateral ridges* (lrN), extending ventrally from the lateral angles. The lateral surface is sharply set off from the anterior surface of the pronotal lobe by weakly impressed lines. Below the pronotal lobes, the pronotum is narrowed and extends ventrally as *postcoxal processes* (1Pc) which nearly meet behind the first coxae.

The remainder of the prothorax, the *prepectus* (Prp) (Fig. 29), is not immovably fused to the mesothorax and is partially concealed by the pronotum. Laterally the *propleuron* is divided diagonally by a transverse *propleural sulcus* (tsPl) into a concealed *lateral portion* (llPl) and exposed *ventral portion* (vlPl). The transverse sulcus terminates posteriorly as a ridge bordering a submarginal groove. The *occipital process* (ocp) projects cephalad from the propleuron and articulates with the postocciput. The occipital process bears sensory setae (Lindauer's organ of Camargo et al., 1967) similar to those of *Apis,* as described by Lindauer and Nedel (1959). The posterior dorsal angle of the lateral portion is prolonged into a *marginal apodeme* (maPr).

The *prosternum* (1S) is partially hidden by the propleura; it projects posteriorly as a triangular plate between the coxae, bearing the *prosternal apophyseal pit* (ap1S). The exposed plate is rimmed by carinae and depressed medially to form a *median groove* (mg), and is expanded laterally beneath the coxae.

The mesothorax is separated from the pronotum by the *first intersegmental groove.* The largest sclerite of the mesonotum is the *mesoscutum* (Sct), which is produced into *anterior-lateral angles* (aaSc) meeting the pronotum above the posterior lobes. *Supra-alar carinae* (sac) extend from these angles to the posterior margin of the mesoscutum. Lateral extensions of the mesoscutum, the *pre-axillae* (Prax), terminate in *anterior mesonotal wing processes.* The mesoscutum is impressed by a *median line* (ml) (anteroadmedian lines of Daly, 1964) and a pair of *parapsidal lines* (pf). Anteriorly the mesoscutum is abruptly rounded and the *mesoscutal lip* (2Nlp) overhangs the pronotum.

The *tegulae* (Tg) (Fig. 34) articulate with the preaxillae and cover the anterior wing bases. They are semi-oval, narrower at the anterior ends, and convex above.

The posterior portion of the mesonotum, the *scutellum* (Scl), is separated by the *scuto-scutellar sulcus* (vs) medially and the *transscutal articulations* (trsa) laterally from the mesoscutum. The *axillae* (Ax) are delimited by *axillary sulci* (axs) and terminate in high *axillary crests* (axcr). The *scutellar crests* (sclcr) form flanges behind the axillae and terminate at the *posterior mesonotal wing processes.*

Each *mesopleuron* is bounded posteriorly by the *2nd pleurointersegmental sulcus* (2pis) (second intersegmental groove of Snodgrass, 1956) which runs dorsally from above the second coxae. Dorsally this groove, interpreted as the *horizontal abscissa of the mesopleural sulcus* (hpls) by Michener (1944), runs horizontally beneath the wing to end in a deep *subalar pit.* Extending from this pit to the anterior margin of the mesopleuron is the *transpleural sulcus* (tpls) (Daly, 1964). The *subalar area* (Saa) above the subalar pit is rimmed by marginal and submarginal ridges and contains the *mesopleural wing process.*

A sulcus running ventrally from the subalar pit is called by Michener (1944) the *pre-episternal sulcus* (pres), interpreted by Richards (1956) as a secondary anterior oblique sulcus, the epicnemial sulcus. It anteriorly sets off the *pre-episternum* (Prep) (or epicnemium, or prepectus, Richards, 1956). The pre-episternum is deeply concave bordering the pronotal lobe at the opening of the mesothoracic spiracle; this concavity is hidden by dense hairs. Extending posteriorly from the pre-episternal sulcus is the *scrobal sulcus* (scrs) which ends at the *episternal scrobe* (scr) and is not continued to the second pleuro-intersegmental sulcus. The *hypoepimeral area* (Hyep) lies above the scrobal sulcus; the area below is the lateral face of the *mesepisternum* (2Eps).

Ventrally extensions of the mesepisterna meet at a *median groove* (mg) (discrimen of Michener, 1944) which bears the *mesosternal apophyseal pit* (ap2s). Each second pleurointersegmental sulcus is continued ventrally as the *precoxal sulcus* (prcs) in front of the second coxa, setting off posteriorly the *katepisternum* (Ktep) (interpreted as the trochantin by Richards, 1956) which bears the condyle of the ventral *coxal articulation.* The katepisternum is continuous with a *lateral intercoxal area* (Licx) extending behind the second coxa. A triangular median area at the anterior margin of the mesosternum, interpreted as the *spinasternum* (Ss) (Richards, 1956), bears the *anterior discriminal pit.* The mesepisternum ventro-laterally bears the elliptical *subpleural signum* (sig).

The *metanotum* (3N) dorsally is bounded posteriorly by the *third intersegmental groove* (3is). Laterally the *trans-metanotal sulcus* (t3Ns) separates the striate *dorso-lateral metanotal area* (d3N) which terminates in a crest behind the scutellar crest.

Each metapleuron is traversed by the *horizontal abscissa of the metapleural sulcus* (hpls) which terminates anteriorly in the *subalar pit,* confluent with the horizontal abscissa of the mesopleural sulcus. The *subalar area* (Saa) above the subalar pit is margined by a ridge containing the *metapleural wing process.* Anterior to the wing process and bordering the mesopleural sulcus is a small *peritreme* (Ptr) in front of the metathoracic spiracle. The *metepisternum* (3Eps) below the subalar pit is bordered posteriorly by the

third intersegmental groove containing the *superior* (spt) and *inferior* (ipt) *metapleural pits;* the line below the inferior pit is the *metapleural sulcus* (3pls) while that above is the *third pleurointersegmental sulcus* (3pis), following Daly (1964). The metapleural sulcus nearly joins the second pleurointersegmental sulcus basally, then curves posteriorly to a point above the third coxa. The *meta-pseudosternal area* (3Pst) below the metapleural sulcus is continuous with the meso-katepisternum and the lateral intercoxal area.

A carinate *metasternum* (3S) (Richards, 1956) projects between coxae II. It laterally meets the meso-katepisterna and medially bears the *metasternal apophyseal pit* (ap3S). A *median groove* (discrimen, Michener, 1944) runs anteriorly from the pit to the margin of the plate.

The *propodeum* is the first abdominal segment fused with the thorax; dorsally the subhorizontal *basal area* (BaPr) consists largely of the *propodeal triangle* (Tri) enclosed by lines extending posteriorly from the ends of the trans-metanotal sulci. The propodeal triangle is rugose and without punctures or hairs. Laterally the *anterior propodeal ridge* extends from the anterior end of the propodeal triangle to the metapleural sulcus. The *lateral surface* (LsPr) of the propodeum extends ventrally to the metapleural sulcus and the *lateral submarginal sulcus* (lsms) which bears a deep shiny pit posteriorly. The *lateral marginal area* (LmPr) it sets off joins the meta-pseudosternal area. The *propodeal spiracle* (Sp) is placed vertically on the lateral surface.

The *posterior surface* (PsPr) of the propodeum is abruptly declivous. The apex of the propodeal triangle extends onto it and ends at the deep *propodeal pit* (ppit). The *posterior marginal area* (PmPr) joins the lateral marginal area at a sharp angle and extends medially to the propodeal pit. Two *propodeal teeth* (th) enclose a circular opening above the fossa. *Apical scales* (asc) are formed below the lateral marginal areas. Strong *lateral carinae* (lcPr) arise at the junctions of the lateral and posterior marginal areas and extend dorsally, diverging slightly and demarking the posterior surface for slightly over half its length. Deep, shiny, oval *posterior submarginal pits* (smpit) border the posterior marginal areas. The posterior marginal areas bear simple hairs which partially obscure the pits. Ventrally the propodeum is largely membranous; small weakly sclerotized areas of the *propodeal sternite* (SPr) occur laterally near the apical scales.

The wing venation of many halictines has been illustrated and utilized in connection with taxonomic works. The homologies of wing veins are in doubt and several interpretations have been proposed, as discussed by Michener (1944). The wings of *Pseudaugochloropsis* (Figs. 35-36) are labeled according to Michener's (1965) interpretation of Ross's system.

Following Michener (1965), I prefer to use morphologically noncommital terms in discussing the following veins and cells of the forewing: *marginal cell* (2nd R_1); *submarginal cells 1* (1st R_1), *2* (1st R_s), and *3* (2nd R_s);

transverse cubital veins 1 (anterior branch R_s), *2* (1st r-m, should be 2nd r-m according to Daly, 1964), and *3* (2nd r-m, should be 3rd r-m, according to Daly, 1964); and *recurrent veins 1* (1st m-cu) and *2* (2nd m-cu). Of special note are the length of the marginal cell and its narrowly truncate and appendiculate apex (Fig. 37), the relative lengths of the submarginal cells, and the arcuate third transverse cubital vein. The first recurrent vein may be received in either the second or third submarginal cell, or may be interstitial with the second transverse cubital vein.

The wing membrane is covered with short erect simple hairs, shorter and denser apically. The wings are traversed by a number of longitudinal creases, the most important of which are shown by dotted lines in Figs. 35 and 36. These creases cause apparent breaks, or pale spots, called *alar fenestrae,* in the veins they cross. Other lesser creases do not "break" the veins. In the forewing, the *submarginal crease* (smcr) crosses the lower ends of the first and second transverse cubital veins and upper end of the second recurrent vein at alar fenestrae. The *vannal fold* (vf) crosses two veins to end at a *vannal incision* in the wing margin. The *jugal lobe* is represented by a very small extension of wing membrane at the base of the forewing. In the hindwing, a corresponding *submarginal crease* (smcr) crosses vein r-m. The *vannal lobe* and *jugal lobe* are distinctly incised and set off by the *vannal* (vf) and *jugal folds* (jf).

The *frenal fold* (frf) of the vannal area of the forewing is sclerotized and turned under, and serves to engage hooks (hamuli, Figs. 38-39) on the costal margin of the hindwing. A series of about 4 very small slightly curved *subbasal hamuli* (bHam) occur about midway between the base of the hindwing and the junction of vein Rs, and a series of 7 or 8 larger, distinctly hooked *distal hamuli* (dHam) occur at and beyond the junction of Rs. As noted by Stavely (1862) and Walter (1907) in other Halictinae, the distal hamuli are not in a continuous evenly spaced series, but rather are clumped.

The basal sclerites of the fore and hind wings are very similar to those illustrated by Michener (1944) for *Anthophora* and Snodgrass (1956) for *Apis,* and are illustrated and labeled in Figs. 40 and 41. The basalares, subalares, and mesopostnotal sclerite (axillary lever of Snodgrass, 1956) are not illustrated. In the forewing, the *median plate* (m) is heavily sclerotized and is the only green sclerite in the wings. Areas of sensilla occur on the bases of the wing veins under the humeral and median plates in the forewing and on the radial and costal sclerites (bases of the veins) in the hindwing.

The legs of females of *Pseudaugochloropsis* (Figs. 42-44) are modified in a number of ways, mostly associated with pollen collecting and nesting behavior. The hairs, especially those of the scopa, are variously branched. Braue (1913) has described the scopal hairs of European halictines and other bees in

some depth and presented a classification of hair types. The present study mentions hair configuration only in passing.

Coxae I articulate close together behind the prosternum. They are concave and shiny on their outer surfaces, the concavities lined by carinae. Coxa II (Fig. 45) is elongate; its upper portion is concealed by the pleuron and the upper articulation is immediately beneath the inferior metapleural pit, according to Michener (1944). The projecting apex of coxa II is set at a sharp angle from the base of the coxa anteriorly but merges with it posteriorly; it is concave and shiny on its outer surface and carinate posteriorly. The hidden base of the coxa is cut by a diagonal groove, notched near the base. Coxa III is not carinate.

Trochanter I is flattened on the posterior surface, and the upper and lower edges are narrowly rounded. Trochanter II is swollen on its upper edge, and somewhat compressed with both edges broadly rounded. Trochanter III is compressed similar to trochanter II, with long plumose scopal hair similar to that of femur III.

Femur I is swollen on its lower surface, the upper part of the posterior surface is flattened and the anterior surface flattened and concave apically. The upper edge is narrowly rounded and the lower edge broadly rounded, somewhat flattened and sharp-angled basally. Femur II is less swollen on its posterior lower surface; its lower edge is narrowly rounded apically, and basally flattened and sharp-angled. It bears a row of stiff setae, the *mesofemoral brush* (brFm), on the base of its anterior surface. Femur III is rounded on all surfaces, swollen basally on the upper surface, and somewhat flattened posteriorly. Long, plumose, tangled, scopal hair arises on the upper and anterior surfaces. The hair structure (Fig. 47) is of type Vc of Braue (1913), recorded by him for *Halictus* femora.

The tibiae of all legs bear movable spurs (sp) at the lower edges of their apices. The basic structure of a spur, as shown in Figs. 51 and 52, consists of a hollow sclerotized tube with two rows of serrations arising on its inner lateral corners (facing the leg). The posterior (inner) row of serrations may be variously modified.

Tibia I is narrowed basally, broadly rounded on its upper and anterior surfaces. The low posterior surface is flattened. Apically tibia I bears a modified spur (Fig. 49), the *fibula*. The inner row of serrations of the fibula is modified basally to form a broad thin transparent *velum,* directed posteriorly. The rest of the spur is termed the *malus*.

Tibia II is shaped similarly to tibia I. It bears a row of stiff, curved, blunt setae on the lower edge of the anterior surface, the *mesotibial comb*. (cbTb). A single apical *tibial spur* articulates anteriorly.

Tibia III is slightly swollen posteriorly, gradually rounded anteriorly, with a sharply angled upper edge. The lower edge is flattened, shiny, and hairless

basally, rounded with long plumose hairs apically. The anterior and posterior surfaces are spiculate with stiff setae. The lower anterior edge bears long plumose hairs (Fig. 48), forming part of the scopa. Braue (1913) records these hairs as type Vb from tibiae of European halictines and Stockhammer (1966) illustrates them for *Augochlora* and also the stout hairs on the upper edge of the tibia, whose function he discusses.

The hind tibia bears two apical spurs, the posterior or *inner tibial spur* is modified by a row of four or five elongate, narrowly rounded teeth formed from the inner row of serrations. The serrations of the *outer tibial spur* are unmodified, although the spur is curved at its apex. In species of some augochlorine genera, the apex of tibia III is slightly prolonged into *tibial spines* on the anterior and dorsal surfaces, but well-developed spines are absent in *Pseudaugochloropsis* and were not systematically studied in other genera.

A hairless *basitibial plate* (Fig. 46) is raised above the surface of tibia III. The anterior edge extends to the tibial articulation, while the posterior edge runs to the base of the tibia. The function of the basitibial plate in a North American halictine is discussed by Batra (1964).

The tarsi are five-segmented, consisting of the *basitarsus* (Btar), nearly equal in length to the remaining tarsomeres combined, the *mediotarsus* of tarsomeres two to four (Mtar), decreasing in length apically, and the longer *distitarsus* (Dtar), which bears the pretarsus at its apex. The basitarsi are strongly compressed and set at an angle in relation to the tibiae, with the lower edge directed anteriorly. The surfaces of the basitarsi are spiculate and clothed with stiff setae, denser posteriorly, and the apices of all basitarsi and mediotarsi bear spine-like setae. Shiny depressions, the *basitarsal pits* (Trpt, Fig. 49), occur at the bases of all basitarsi. The distitarsi are slightly depressed dorso-ventrally and covered with fine setae, denser on the lower surfaces.

Basitarsus I bears a shiny semicircular depression at its base on the anterior surface, the *strigilar concavity* (Stcav). It is lined with a row of wide blunt setae, the *strigilar comb* (Comb), which projects posteriorly. This concavity plus the tibial fibula comprise the *strigilis* (Fig. 49) or antenna cleaner, whose function is described by Snodgrass (1956) for *Apis*. The anterior basitarsus is more broadly rounded on its posterior than on its anterior surface and the lower edge is narrowly rounded. Its upper edge is sharp-angled and somewhat carinate and produced apically into a *distal process* (dp), which overlaps the mediotarsus. This edge is lined with a distinct row of flattened setae, the *anterior basitarsal brush* (brTr, Fig. 50), quite noticeable when the basitarsus is viewed with the edge facing the observer. This brush was also described by Sakagami and Wain (1966) for an Indian halictine, and a possible function is discussed by Batra (1968) for a North American halictine.

The structure of the middle tarsus agrees with that of the fore, except that

the basitarsus is not carinate nor produced apically on its upper surface and does not bear a basitarsal brush.

The hind tarsi are more strongly compressed, both surfaces being only slightly rounded and both edges sharp. The setae on the posterior surface are particularly strong and dense, forming a *tarsal comb,* while the setae on the upper edge of the basitarsus are pectinate, similar to those of the tibial edge. The basitarsus is produced apically into a *distal process* (dp) which bears a dense brush of hairs on its anterior surface, the *penicillus* (pen) (posterior basitarsal brush of Michener, 1944). Batra (1964) named this structure and described its function for a North American halictine. The hairs comprising the penicillus are of an unusual structure (Fig. 56), spatulate and usually fringed at the ends. Braue (1913) described similar hairs as type X in the penicillus of *Anthophora.*

The *pretarsi* of all legs resemble closely those of *Apis* (Snodgrass, 1956) and *Anthophora* (Michener, 1944) and are labeled accordingly in Figs. 54 and 55. The camera of Michener is called the *arcus* (Arc) by Snodgrass, likewise the auxilium is termed the *auxiliary sclerite* (Aux). The *manubrium* (Mn) of Snodgrass (orbicula of Michener) is elongate and tapers apically, bearing two pairs of long plumose setae in addition to smaller basal setae. The *claws* or ungues are subapically toothed on their inner sides and bear two pairs of long setae on their lower surfaces, the proximal pair of which is pectinate, in addition to smaller setae. The mechanism of the pretarsus is described by Snodgrass (1956).

Metasoma. Following Michener (1965) the abdomen behind the propodeum is termed the *metasoma,* and the metasomal segments are numbered from one on. The metasoma is oval (Fig. 64), broadest at the third metasomal segment, and tapered apically. Six *metasomal terga* are visible externally, the last nearly hidden. The terga bend strongly downwards and inwards laterally and overlap the sterna. The six externally visible *metasomal sterna* are much flatter and exposed only ventrally.

Metasomal tergum I (Figs. 87-88) is strongly narrowed basally to form the *petiole* which articulates with the mesosoma. The anterior margin of the petiole bears a strong transverse ridge, the *petiole acrotergite* (Act). A *median petiole plate* (Ptpl) (vertical plate of Michener, 1944) projects anteriorly to articulate with the propodeal teeth. The base of the median plate is set in a depression at the base of the *median sulcus* (ms). To either side of the median plate on the petiole neck are patches of sensory setae (Nedel's organ of Camargo et al., 1967), whose function was described by Lindauer and Nedel (1959) for *Apis.* The mechanism of the petiole was described by Snodgrass (1956) for *Apis.* Metasomal tergum I consists of three surfaces: the *anterior surface* (an) bears long erect hairs; the *dorsal surface* (do) bears appressed hairs; and the *ventro-lateral surfaces* (vl) overlap metasomal

sternum I laterally and are set off from the anterior and dorsal surfaces by *ventro-lateral lines* (vll). The anterior surface bears a pair of *spiracles* (Sp.) The *posterior marginal area* (pma) is depressed.

Metasomal terga II to IV (Figs. 89, 57-58) are similar in structure. Basally a tergum is margined by an internal ridge, the *antecosta* (An), which terminates in *tergal apodemes* (Ap) before the lateral margins of the tergum. The tergal apodemes are located progressively nearer the lateral margins and become progressively larger in more posterior terga. The *gradulus* (Grd) separates the anterior *pregradular* (Prga) from the posterior *postgradular area* (Poga). The pregradular area projects slightly over the postgradular area, and a membrane lined with fine hair-like microtrichae, the *gradular lip* (grl), hangs over the postgradular area. The graduli of terga III and IV have *gradular angles* (gra) laterally, and then extend posteriorly. Posterior extensions of the graduli progressively increase in length in more posterior terga. The *spiracles* (Sp) are located just lateral to the gradular angles and are hidden by overlapping terga. The *ventro-lateral areas* (vl) of the terga overlap the lateral margins of the corresponding sterna. The postgradular areas are depressed just posterior to the graduli and also on the *posterior marginal areas* (pma).

The postgradular area of metasomal tergum V (Figs. 59-60) apically is covered with long plumose hairs, the *prepygidial fimbria*. The thin *pseudopygidial area* (Ppa) extends from a median invagination of the more heavily sclerotized and pigmented postgradular area and is densely covered with setae, shorter and not plumose on either side of a *median slit*. The apical margins of the tergum, from about below the posterior extensions of the gradulus to the lateral edges of the pseudopygidial area, are bordered with a row of strong *latero-marginal setae*.

Metasomal tergum VI (Figs. 61-63) is considerably smaller than V and narrowed apically. The gradulus is reduced, not angulate, and ends laterally distant from the spiracles, with a very small lip. Medially the gradulus ends to either side of a heavily sclerotized, protuberant *suprapygidial plate* (Supg), which is narrowed at a transverse ridge and continued apically to expand into a thick truncate *pygidial plate* (Pyg). The postgradular area is clothed with long dark plumose hairs, the *pygidial fimbria*. The posterior marginal area is thin and hairless except for fine setae on the margin; it terminates medially on the inner surface of the pygidial plate. The pregradular area is clothed with fine hairs above the suprapygidial plate. Batra (1964) illustrated terga V and VI and discussed their function in a North American halictine.

Metasomal sternum I (Figs. 87, 98) anteriorly forms the ventral surface of the petiole. The V-shaped *antecosta* (An) sets off a narrow *acrosternite* (Acs), which laterally bears patches of sensory setae comparable to those whose function is discussed by Lindauer and Nedel (1959) for *Apis*. The

basal area (ba) of the postgradular area is elevated medially and bears short setae on either side, as well as a poorly defined *median line* (ml). The graduli extend only laterally. The long plumose postgradular hairs of sterna I and II and to some extent those of more posterior sterna form a supplementary scopa.

Metasomal sternum II (Fig. 65) is margined anteriorly by the strongly notched antecosta, which terminates at the *sternal apodemes* (Ap). The gradulus extends medially and posteriorly below the apodemes. Laterally the *dorso-lateral areas* (dlS) are expanded into thin flaps which extend dorsally beneath the overlapping tergum. On either side of the midline, the pregradular area bears patches of sensory setae. The postgradular area basally bears very short setae where sternum III overlaps, more apically it bears long plumose setae, longest just before the depressed posterior marginal area.

Metasomal sterna III to V (Figs. 66-68) are similar, progressively decreasing in size. The antecosta forms a strong internal ridge and extends across the bases of the sternal apodemes, which are considerably larger than those of sternum II and bear upturned *dorsal processes* (dp). A narrow *acrosternite* (Acs) is anterior to the antecosta. There is no gradulus, and the "pregradular area" does not bear distinct patches of sensory setae, although there are very fine setae near the antecosta. The setae of the "postgradular area" are similar to those of sternum II.

Metasomal sternum VI (Figs. 69-70) is narrowed posteriorly to a rounded apex, and the dorso-lateral areas are strongly curved upwards inside tergum VI. The antecosta is developed only laterally and the sternal apodemes are directed mesally. The gradulus is only weakly defined near the apex.

The genital segments are confined within the genito-anal chamber formed by tergum and sternum VI. Metasomal segments VII and VIII are modified to form the ovipositor or *sting,* very similar in structure to those of *Apis* (Snodgrass, 1956) and *Anthophora* (Michener, 1944, 1956). Figures 71 to 76 illustrate the sclerotized portions of the sting, using the morphologically noncommital terminology of Snodgrass; Michener's terms are cited in parentheses following. The *spiracle plates* (Fig. 72) (metasomal hemitergites VII) are joined by membrane and lie lateral to the sting; they are removed in Fig. 71. The sting proper consists of a pair of *oblong plates* (Ob) (2nd valvifers) which are overlapped by the *quadrate plates* (Qd) (metasomal hemitergites VIII). Articulating with both plates is the *triangular plate* (Tri) (1st valvifer). Two pairs of *rami* (r) connect the valvifers with their respective valvulae. The *shaft* (Stng, Fig. 76) of the sting is composed of a central *stylet,* the fused second valvulae, which are enlarged basally to form the *bulb* of the sting. The stylet is closely appressed by a pair of *lancets* (Lan) (first valvulae) which basally are expanded into *valves* (Vlv) which lie within the bulb. Dorsally the Y-shaped *furcula* (Figs. 73-74) (stylet apodemes) surmounts the bulb. The sting *sheaths* (Sh) (gonostyli) lie to either

side of the shaft at rest and articulate with the oblong plates. Medially they are concave and membranous, laterally sclerotized with abundant plumose setae apically and stronger setae near their bases. Metasomal tergum IX (not illustrated) is represented by a lightly sclerotized area above the anus, bearing sensilla. The mechanism of the sting in *Apis* was described by Snodgrass (1956).

Male

The male of *Pseudaugochloropsis graminea* differs from the female in many minor characteristics, such as punctation, pubescence, color, and proportions of structures, but these are not dealt with below. Only structures which differ from those of the female in a significant way are described.

Head. The male head (Figs. 77-78) is narrower below; the clypeal margin is without a marginal row of strong setae and the clypeal teeth are shorter. Posteriorly, the postgenal lobes (Fig. 80) meet at the posterior flange of the hypostomal carinae. Ventrally, the hypostomal lobes also meet at the posterior flange. The para-mandibular processes are thinner extensions of the hypostoma, lacking the flattened carinae of the female. The mandibular sockets are considerably narrower.

The antennae (Fig. 79) are longer in the male and composed of 13 segments. The scape is comparatively shorter, comprising less than one-fifth of the total length. The flagellum is somewhat flattened and nearly devoid of sensilla on its lower surface; the terminal flagellomere is hooked and bare at its apex.

The basal area of the male labrum (Figs. 81 and 82) merges gradually into the distal process. The basal elevation extends nearly the width of the basal area, has no sharply differentiated apical face, and is invaginated medially. The distal process lacks a keel.

The male mandible (Figs. 83-84) is simpler than that of the female. The subapical tooth is lacking, although the anterior grooves and ridge are present. The outer posterior groove and the diagonal ridge are also lacking.

Mesosoma. The hair is generally less dense and shorter on all leg surfaces in the male. On the fore leg, the upper edge of the basitarsus is not prolonged into a distal process, nor is it carinate, and there is no basitarsal comb.

On the middle leg, the lower edge of the femur is not flattened basally and does not bear a mesofemoral brush. The mesotibial comb is present but poorly formed of shorter, straighter, weaker setae.

The hind leg (Fig. 85) does not bear a scopa, consequently the hairs are considerably shorter and less dense. The femur is not as swollen, lacks the dense long scopal hairs, but exhibits a flattened dull area at the base of the anterior surface which bears short, fine, simple hairs. The basitibial plate is only weakly indicated by a shiny hairless area. The inner tibial spur (Fig. 86) is not pectinate, although some of the serrations of the inner row are

enlarged distally. The distal process of the basitarsus is not as produced and lacks the penicillus.

Metasoma. The principal external differences between the sexes of **Pseudaugochloropsis** lie in the metasoma, especially the genitalia. The male metasoma (Fig. 97) is relatively narrower than that of the female and consists of seven externally visible terga and six externally visible sterna. Terga III and IV (Figs. 90-91) differ slightly from those of the female as to the gradulus; the gradular angle is less prolonged, and the posterior extensions of the gradulus are shorter.

Metasomal tergum V (Fig. 92) is not as narrow posteriorly and lacks the prepygidial fimbria and pseudopygidial area. The gradulus follows the trend established in III and IV. Tergum VI (Fig. 93) lacks all modifications connected with the pygidial area, including the pygidial fimbria. The gradulus is not produced at the gradular angles and is very slightly extended posteriorly.

Metasomal tergum VII (Figs. 94-95) is the last externally visible tergum. It is relatively short, with the lateral areas bent sharply back from the dorsal area and not overlapping a sternum. The rounded tergal apodemes are at the extreme corners and only slightly produced beyond the level of the antecosta. A gradulus is lacking; the "pregradular area" is sharply delineated from a nearly vertical "postgradular area," seen in lateral view. The "postgradular area" bears long plumose setae apically.

Metasomal tergum VIII (Fig. 96) is normally concealed beneath tergum VII in the roof of the genito-anal chamber. It is a small mostly membranous structure, only the lateral tergal apodemes being well sclerotized, connected by a ventral membrane. The structure of this tergum and its posterior extension, the *proctiger* (Pr) of metasomal segment IX, was analyzed by Snodgrass (1941) for other Apoidea, and his analysis is followed here. The proctiger extends as a membranous tube enclosing the hindgut from the posterior extensions of tergal apodemes VIII. It bears a weakly sclerotized *subanal plate* (Sban) on its ventral floor. The posterior margin of the ventral membrane, the *anal lip* (Anl), is fringed with finger-like *post-anal filaments* (fil), brownish extensions of the membrane covered with hair-like microtrichae. Normally the filaments are folded into the proctiger, the subanal plate then situated at the apex of the proctiger. The filaments can be everted by probing with a minuten nadel between the dorsal and ventral membranes from the anterior end of the proctiger. In dry specimens, the filaments are occasionally seen everted and protruding beneath the apex of tergum VII.

Sternum II (Fig. 99) is similar to that of the female, but relatively longer, and the gradulus extends nearly to the posterior margin. The apodemes of sternum III (Fig. 100) lack well-defined dorsal processes and also lack the acrosternite. The gradulus extends anteriorly nearly to the antecosta and posteriorly nearly to the posterior margin; a well-defined gradular lip is pres-

ent. The postgradular area is largely clothed with short setae. The setae are longest laterally just anterior to the posterior marginal area.

Metasomal sternum IV (Fig. 101) resembles sternum III but possesses a distinctive hair arrangement. Most conspicuous is a V-shaped median patch of dense erect setae, extending from the posterior margin to a basal patch of short setae.

Metasomal sternum V (Fig. 102) is broadly emarginate posteriorly. The gradulus meets the antecosta medially, and the antecosta does not extend across the bases of the sternal apodemes. The postgradular area is nearly without setae basally, and posteriorly bears two conspicuous setal patches. The posterior marginal area is strongly depressed. This sternum was illustrated by Eickwort (1967).

Metasomal sternum VI (Fig. 103) differs considerably from that of the female and more nearly resembles sternum V of the male. The dorso-lateral areas are bent sharply upwards. The gradulus broadly joins the antecosta. The posterior marginal area is strongly depressed and notched medially. The postgradular area bears dense long setae posteriorly, but is nearly without setae basally.

Metasomal sterna VII and VIII (Figs. 104-106) are small weakly sclerotized structures hidden beneath sternum VI in the genito-anal chamber and closely associated with the genitalia. Sternum VIII lies above sternum VII and is fused to it laterally, so that the two appear to be one structure when dissected and are separated only with difficulty. Sternum VII is narrowly tranverse, bearing anterio-lateral sternal apodemes and two thin posterio-lateral projections clothed with short setae at their tips. Sternum VIII is more complex, being a two-layered structure with the layers joined anterio-medially and laterally at their fusion with sternum VII. Anteriorly the sternum is produced into a median keeled *spiculum* (Spc); posteriorly it is bordered by long plumose setae.

The male genitalia of Hymenoptera have been subjected to many interpretations and nomenclatorial schemes. A perusal of this subject is beyond the scope of this study. While usage of a morphologically noncommital terminology would be preferred, a view Michener now shares (Michener, pers. comm.), the terminology originally used by Michener (1944, 1956) is now so widely applied in studies of bee taxonomy that it is followed here. Its usage in this study does not necessarily imply an acceptance of morphological homologies that the terms indicate. Comparative terms used by Snodgrass were cited by Michener (1956). Two studies of hymenopteran genitalia should be cited here: that of Beck (1933) which included an augochlorine bee, and that of Snodgrass (1941), which unfortunately did not include any Halictinae, although many other bees were described. Both studies included

the associated hidden sterna and terga. Michener (1954) illustrated the genitalia of many augochlorine genera.

The *gonobase* (Gb) of the genitalia (Figs. 107-111) ventrally encloses the *genital foramen* by a pair of posteriorly extending *ventral gonobasal arms* (vga). A membranous *ventral gonobasal bridge* (vgb), sclerotized in many other species, connects these arms. A *median sulcus* (ms) denotes the presence of an internal ridge. The *dorsal lobes* of the gonobase slightly overlap the bases of the gonocoxites.

The *gonoforceps* (parameres of Snodgrass, 1957) are complicated structures forming the lateral walls of the genitalia. As they are not divided by an articulation into distal and basal parts, the identity of basal *gonocoxites* (Gcx) and distal *gonostyli* (telomeres of Snodgrass, 1957) cannot be ascertained with certainty. An arbitrary distinction is made in *Pseudaugochloropsis* wherein a transverse ridge dorsally and a diagonal line ventrally separate the distal gonostylus. Similar separations can be made in other augochlorine genitalia.

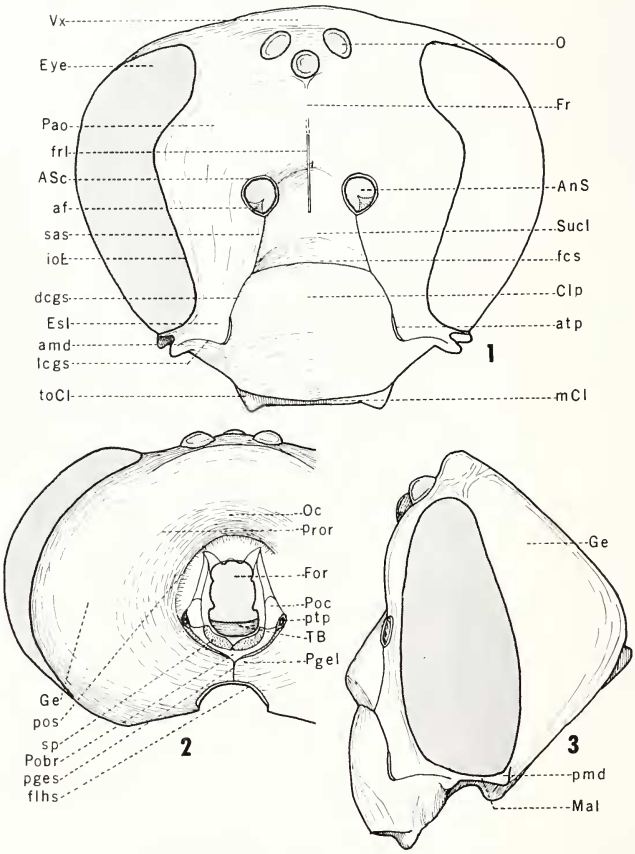
The gonocoxites are joined at their bases by a *dorsal gonocoxal bridge* (dcb). Ventrally, a pair of arms extend medially beneath the ventral gonobasal arms to form the *ventral gonocoxal bridge* (vcb).

Each gonostylus is prolonged as a setose *ventral process* (vst), the medial margin of which is lined with especially thick setae. Extending medially from the ventral inner margin is a thin transparent flap, the *ventral parapenial lobe* (par). The *dorsal process* (dst) of the gonostylus is set off by a membranous area from the apical ridge of the gonocoxite. The dorsal process is produced apically to form a ventrally directed convex surface, bearing short setae. Long setae arise dorsally near the base of the gonostylus. The ventral structure of the gonostylus was illustrated in greater detail by Eickwort (1967).

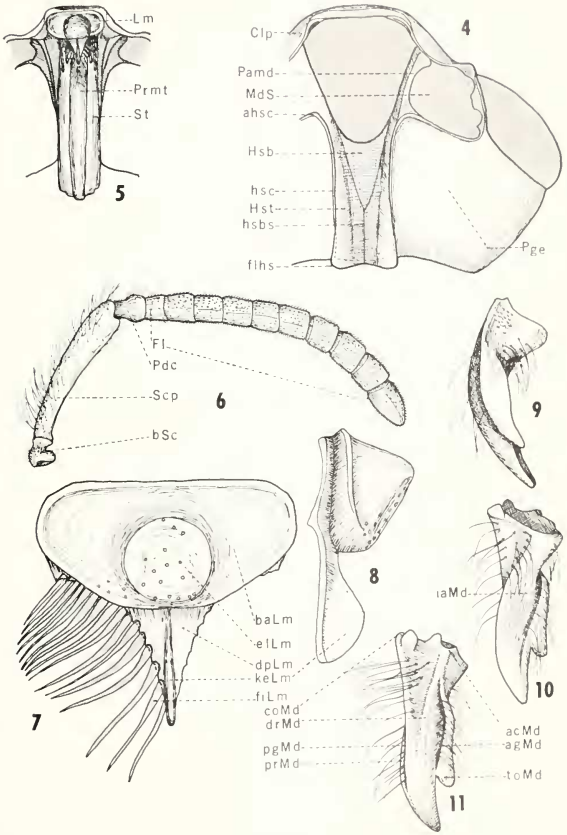
Between the gonoforceps, the *aedeagus* is composed of the *penis* (Pen) which is laterally bordered by a pair of *penis valves* (Pv) (sagittae of Snodgrass, 1957). The penis is entirely membranous and was not studied in detail.

The penis valves (Fig. 111) are heavily sclerotized structures, connected by a small *dorsal bridge* (dbpv), only the posterior border of which is well sclerotized. Each valve bears a *basal median projection* (bmpv) posterior to the *apodeme* (Ap) of the penis valve (aedeagal apodeme of Snodgrass, 1957). Apically, a dorsal transverse depression is continuous with a diagonal groove that runs to the inner edge of the basal median projection. The penis valve is expanded laterally at the level of the transverse depression. A strong *dorsal crest* (dcpv) terminates at the apical end of the transverse groove. The crest is darkly pigmented at its apex and bears short setae, and is longitudinally grooved and carinate. The lateral margin of the penis valve is extended apically lateral to the crest and bears setae. The apex of the penis valve is bent ventrally and pointed. Ventrally the penis valve bears long setae.

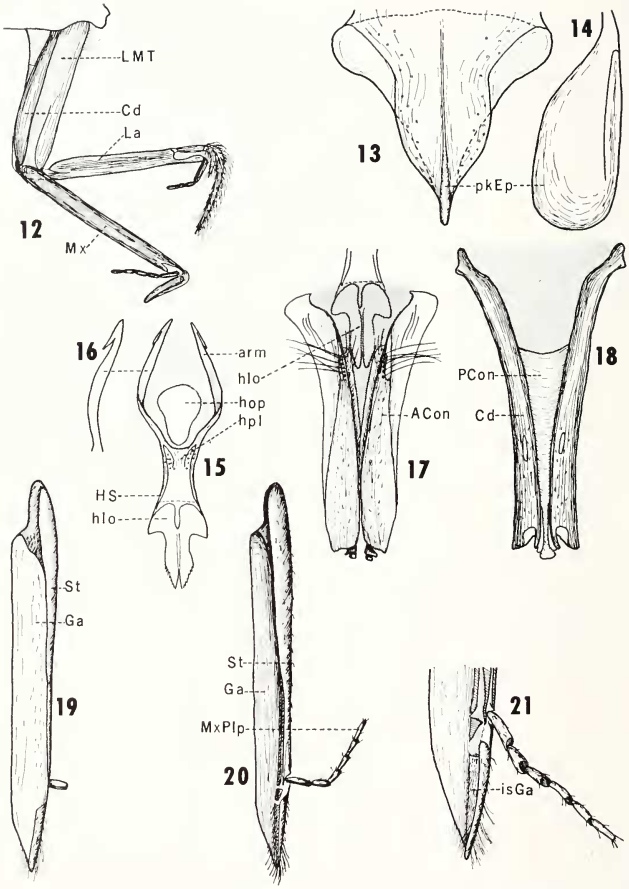
The *volsellae* (Vol, Fig. 110) are two sclerotized plates lying ventral to the penis. Each volsella is notched medially, rounded apically, and laterally indented by a *volsellar notch* (vnt). The volsellar notch separates the slightly movable lateral *cuspis* (Cu) from the median *digitus* (Di). The notch borders are pigmented and bear small teeth; the cuspis border bears very small hairs projecting into the notch. Internally the cuspis is characterized by a strong ridge, and a weaker internal ridge margins the digitus.



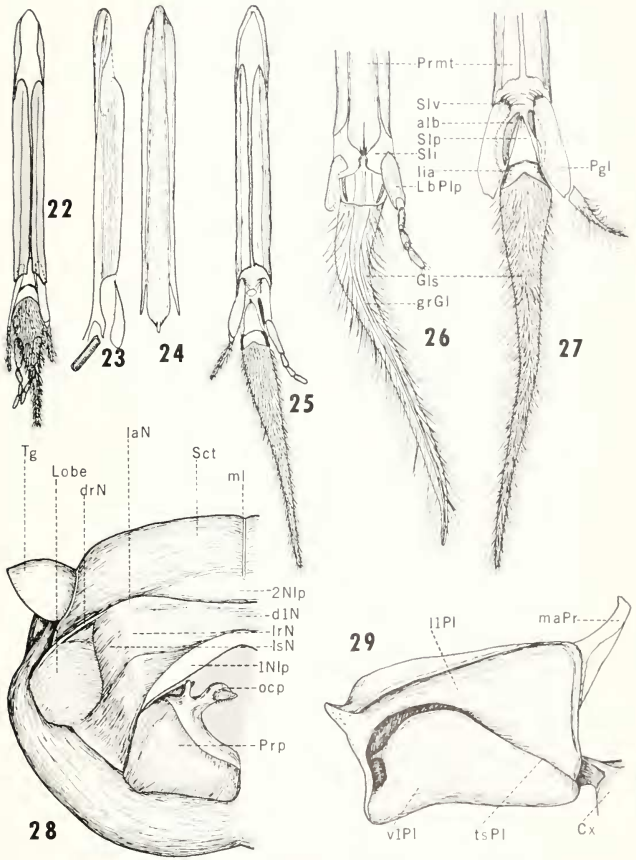
FIGS. 1-3. Head of *Pseudaugochloropsis graminea* female. **1**, front; **2**, posterior; **3**, lateral. **af**—antennifer; **amd**—anterior mandibular articulation; **Ans**—antennal socket; **ASc**—antennal sclerite; **atp**—anterior tentorial pit; **Clp**—clypeus; **dcgs**—dorsal clypeo-genal sulcus; **Esl**—epistomal lobe; **Eye**—compound eye; **fcs**—fronto-clypeal sulcus; **flhs**—posterior flange of hypostomal carina; **For**—occipital foramen; **Fr**—frons; **frl**—frontal line; **Ge**—genal area; **ioE**—inner orbit of eye; **lcgs**—lateral clypeo-genal sulcus; **Mal**—malar area; **mCl**—marginal area of clypeus; **O**—ocellus; **Oc**—occiput; **Pao**—parocular area; **Pgel**—post-genal lobe; **pges**—post-genal suture; **pmd**—posterior mandibular articulation; **Pobr**—postoccipital bridge; **Poc**—postocciput; **pos**—postoccipital suture; **Pror**—preoccipital ridge; **ptp**—posterior tentorial pit; **sas**—subantennal sulcus; **sp**—setal plate; **Sucl**—supraclypeal area; **TB**—tentorial bridge; **toCl**—clypeal tooth; **Vx**—vertex.



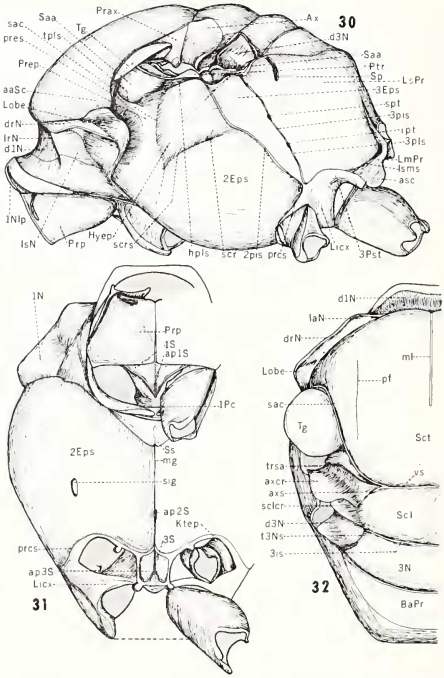
Figs. 4-11. *Pseudaugochloropsis graminea* female. **4**, ventral region of head; **5**, mouthparts folded into proboscidial fossa; **6**, antenna; **7-8**, labrum (7, anterior; 8, lateral); **9-11**, mandible (9, anterior; 10, inner; 11, outer). **acMd**—mandibular acetabulum; **agMd**—outer anterior groove of mandible; **ahsc**—anterior angle of hypostomal carina; **baLm**—basal area of labrum; **bSc**—basal bulb of scape; **Clp**—clypeus; **coMd**—mandibular condyle; **dpLm**—distal process of labrum; **drMd**—outer diagonal ridge of mandible; **elLm**—basal elevation of labrum; **fiLm**—labral fimbria; **Fl**—flagellum; **flhs**—posterior flange of hypostomal carina; **Hsb**—hypostomal bridge; **hsbs**—hypostomal bridge suture; **hsc**—hypostomal carina; **Hst**—hypostoma; **iaMd**—inner anterior groove of mandible; **keLm**—distal keel of labrum; **Lm**—labrum; **MdS**—mandibular socket; **Pamd**—paramandibular process; **Pdc**—pedicel; **Pge**—postgena; **pgMd**—outer posterior groove of mandible; **prMd**—outer posterior ridge of mandible; **Prmt**—prementum; **Scp**—scape; **St**—stipes; **toMd**—subapical tooth of mandible.



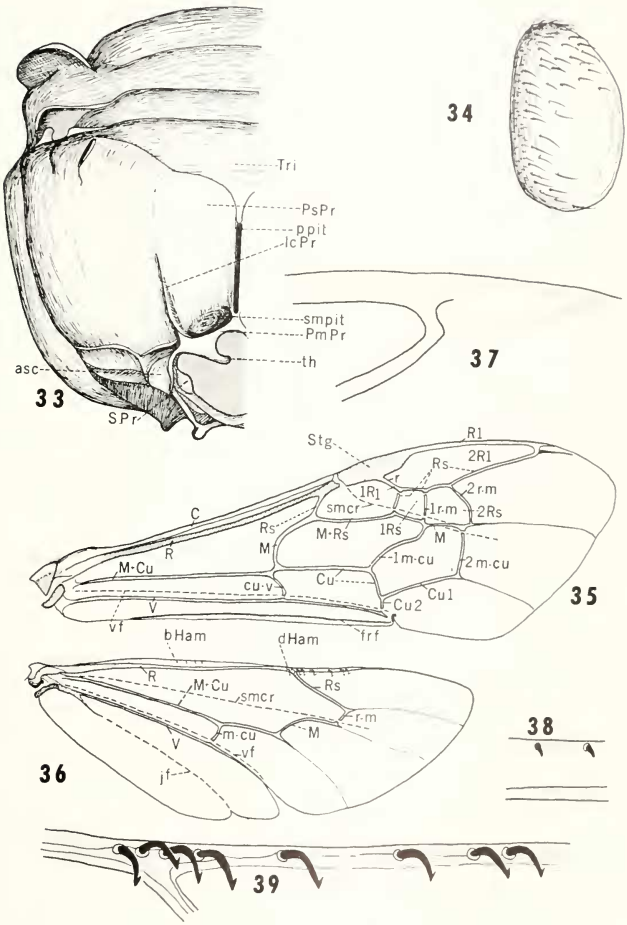
FIGS. **12-21.** Mouthparts of *Pseudaugochloropsis graminea* female. **12,** lateral view of extended proboscis; **13-14,** epipharynx (13, posterior; 14, lateral); **15,** basal portion of hypopharynx; **16,** lateral view of hypopharyngeal arm; **17-18,** labio-maxillary tube (17, anterior; 18, posterior); **19-21,** distal portion of maxilla (19, posterior; 20, anterior; 21, anterior view of post-palpal portion of galea). **ACon**—anterior conjunctival thickening; **arm**—hypopharyngeal arm; **Cd**—cardo; **Ga**—galea; **hlo**—hypopharyngeal lobe; **hop**—median oral plate; **hpl**—hypopharyngeal plate; **HS**—hypopharyngeal suspensorium; **isGa**—inner strip of galea; **La**—labium; **LMT**—labio-maxillary tube; **Mx**—maxilla; **MxPlp**—maxillary palpus; **PCon**—posterior conjunctival thickening; **pkEp**—posterior keel of epipharynx; **St**—stipes.



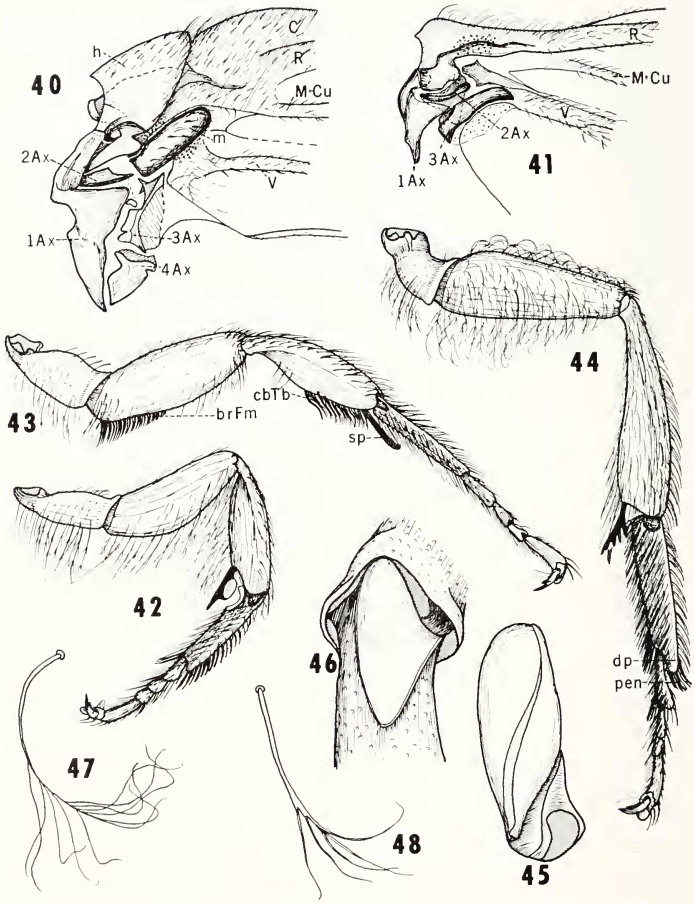
Figs. **22-29.** *Pseudaugochloropsis graminea* female. **22-27,** distal portion of labium: **22,** ligula retracted into prementum; **23-24,** prementum (23, lateral; 24, posterior); **25,** ligula extended, anterior view; **26-27,** ligula (26, posterior; 27, anterior); **28,** anterior view of mesosoma; **29,** prepectus. **alb**—anterior longitudinal brace; **Cx**—coxa; **d1N**—dorsal surface of pronotum; **drN**—dorsal ridge of pronotum; **Gls**—glossa; **grGl**—median groove; **laN**—lateral angle of pronotum; **LbPlp**—labial palpus; **lia**—ligular arm; **Lobe**—pronotal lobe; **l1Pl**—lateral portion of propleuron; **lrN**—lateral ridge of pronotum; **lsN**—lateral surface of pronotum; **maPr**—marginal apodeme of prepectus; **ml**—median line of mesoscutum; **1Nlp**—pronotal lip; **2Nlp**—mesoscutal lip; **ocp**—occipital process; **Pgl**—paraglossa; **Prmt**—prementum; **Prp**—prepectus; **Sct**—mesoscutum; **Sli**—subligular plate; **Slp**—salivary plate; **Slv**—salivarium; **Tg**—tegula; **tsPl**—transverse propleural sulcus; **v1Pl**—ventral portion of propleuron.



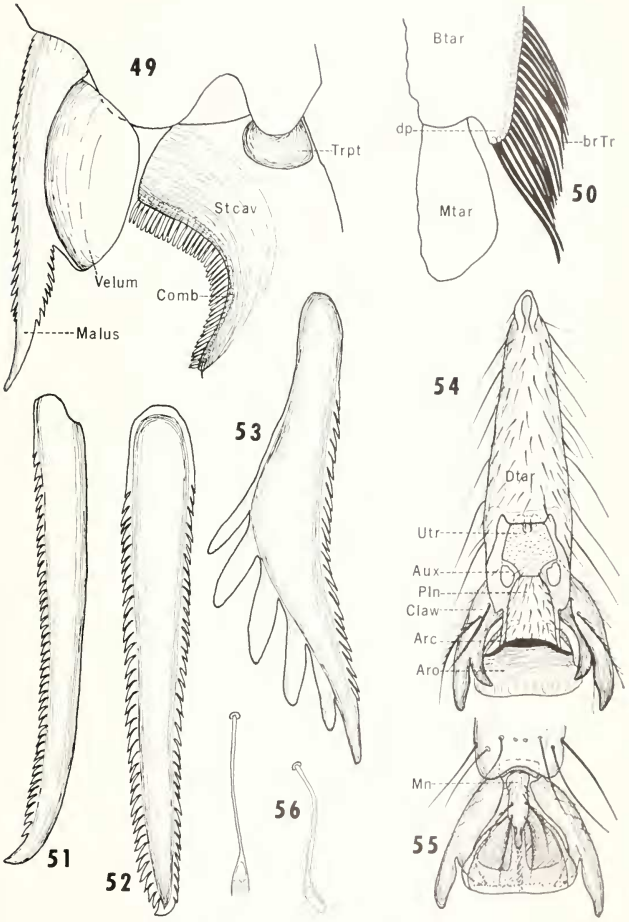
FIGS. 30-32. Mesosoma of *Pseudaugochloropsis graminea* female. **30,** lateral; **31,** ventral; **32,** dorsal. **aaSc**—anterior-lateral angle of mesoscutum; **ap1S, 2S, 3S**—sternal apophyseal pits; **asc**—apical scale; **Ax**—axilla; **axcr**—axillary crest; **axs**—axillary sulcus; **BaPr**—basal area of propodeum; **d1N**—dorsal surface of pronotum; **d3N**—dorso-lateral metanotal area; **drN**—dorsal ridge of pronotum; **2Eps, 3Eps**—episterna; **hpls**—horizontal abscissas of pleural sulci; **Hyep**—hypoepimeral area; **ipt**—inferior metapleural pit; **3is**—3rd intersegmental groove; **Ktep**—katepisternum; **laN**—lateral angle of pronotum; **Licx**—lateral intercoxal area; **LmPr**—lateral marginal area of propodeum; **Lobe**—pronotal lobe; **lrN**—lateral ridge of pronotum; **lsms**—lateral submarginal sulcus of propodeum; **lsN**—lateral surface of pronotum; **LsPr**—lateral surface of propodeum; **mg**—median groove; **ml**—median line of mesoscutum; **1N**—pronotum; **3N**—metanotum; **1Nlp**—pronotal lip; **1Pc**—postcoxal process; **pf**—parapsidal line; **2pis, 3pis**—pleurointersegmental sulci; **Apls**—metapleural sulcus; **Prax**—pre-axilla; **prcs**—precoxal sulcus; **Prep**—pre-episternum; **pres**—pre-episternal sulcus; **Prp**—prepectus; **3Pst**—metapseudosternal area; **Ptr**—peritreme; **1S**—prosternum; **3S**—metasternum; **Saa**—subalar area; **sac**—supra-alar carina; **Scl**—scutellum; **sclcr**—scutellar crest; **scr**—episternal scrobe; **scrs**—scrobal sulcus; **Sct**—mesoscutum; **sig**—subpleural signum; **Sp**—spiracle; **spt**—superior metapleural pit; **Ss**—spinasternum; **Tg**—tegula; **t3Ns**—trans-metanotal sulcus; **tpls**—transpleural sulcus; **trsa**—transscutal articulation; **vs**—scuto-scutellar sulcus.



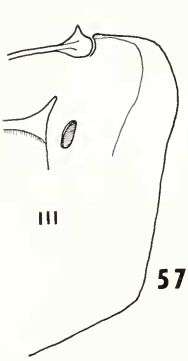
Figs. 33-39. *Pseudaugochloropsis graminea* female. 33, posterior view of mesosoma; 34, tegula; 35, forewing; 36, hindwing; 37, apex of marginal cell; 38, subbasal hamuli; 39, distal hamuli. asc—apical scale; bHam—subbasal hamuli; dHam—distal hamuli; frf—frenal fold; jf—jugal fold; lcPr—lateral carina of propodeum; PmPr—posterior marginal area of propodeum; ppit—propodeal pit; PsPr—posterior surface of propodeum; smcr—submarginal crease; smpit—posterior submarginal pit of propodeum; SPr—propodeal sternite; Stg—stigma; th—propodeal tooth; Tri—propodeal triangle; vf—vannal fold.

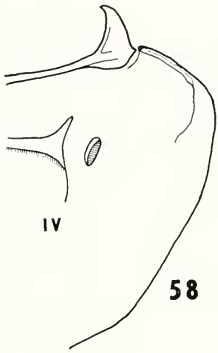


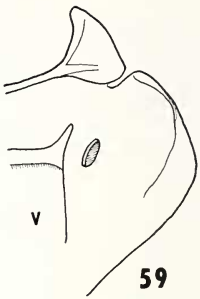
FIGS. 40-48. *Pseudaugochloropsis graminea* female. **40-41,** bases of wings (40, forewing; 41, hindwing); **42-44,** legs, excluding coxae, posterior views (42, fore; 43, middle; 44, hind); **45,** middle coxa; **46,** basitibial plate; **47-48,** scopal hairs (47, of femur; 48, of tibia). **1Ax, 2Ax, 3Ax, 4Ax**—axillaries; **brFm**—mesofemoral brush; **cbTb**—mesotibial comb; **dp**—distal process; h—humeral plate; **m**—median plate; **pen**—penicillus; **sp**—tibial spur.

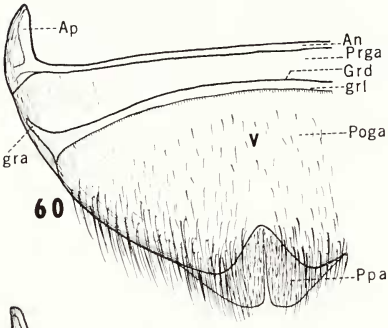


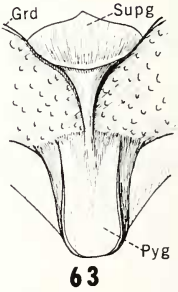
Figs. **49-56.** Legs of *Pseudaugochloropsis graminea* female. **49,** strigilis; **50,** anterior basitarsal brush; **51-52,** outer hind tibial spur (51, lateral view; 52, inner view); 53, inner hind tibial spur; **54-55,** pretarsus (54, ventral; 55, dorsal); **56,** hairs of penicillus. **Arc**—arcus; **Aro**—arolium; **Aux**—auxiliary sclerite; **brTr**—anterior basitarsal brush; **Btar**—basitarsus; **Comb**—strigular comb; **dp**—distal process; **Dtar**—distitarsus; **Mn**—manubrium; **Mtar**—mediotarsus; **Pln**—planta; **Stcav**—strigular concavity; **Trpt**—basitarsal pit; **Utr**—unguitractor.

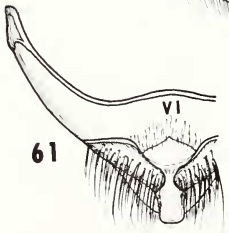


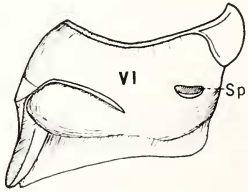




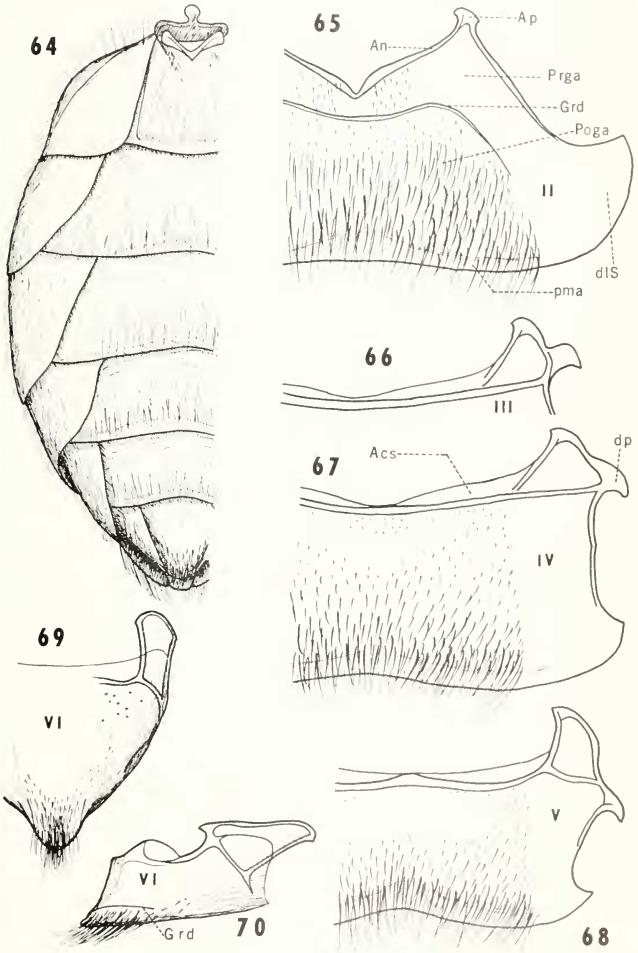




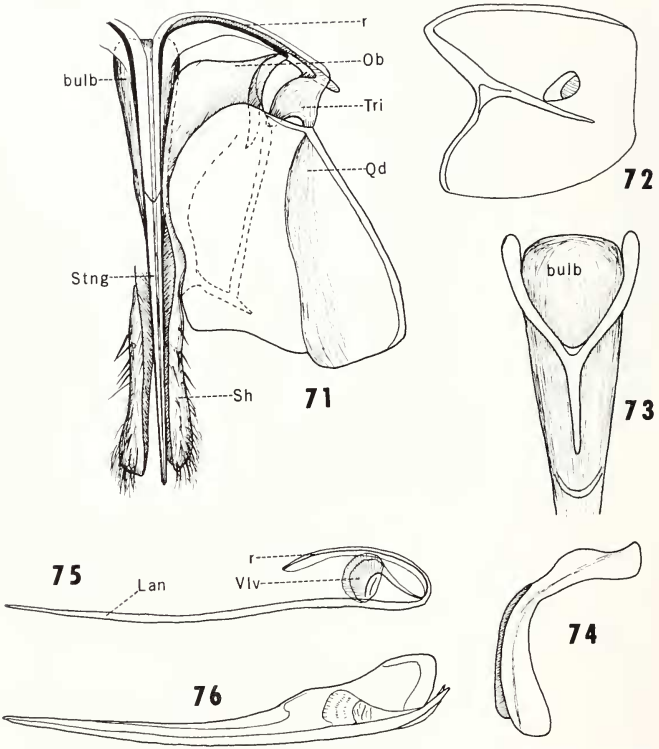




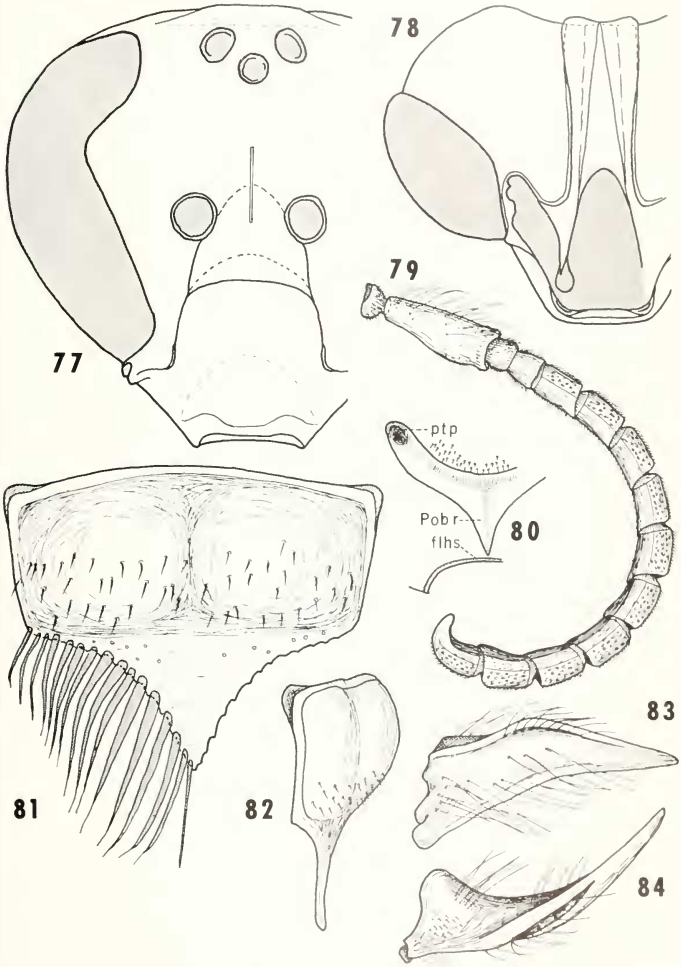
FIGS. **57-63.** Metasomal terga of *Pseudaugochloropsis graminea* female. **57,** tergum III; **58,** tergum IV; **59-60,** tergum V (59, lateral; 60, dorsal); **61-63,** tergum VI (61, dorsal; 62, lateral; 63, pygidial area). Hairs not shown on 57-59, 62-63. **An**—antecosta; **Ap**—tergal apodeme; **gra**—gradular angle; **Grd**—gradulus; **grl**—gradular lip; **Poga**—post-gradular area; **Ppa**—pseudopygidial area; **Prga**—pre-gradular area; **Pyg**—pygidial plate; **Sp**—spiracle; **Supg**—supra-pygidial plate.



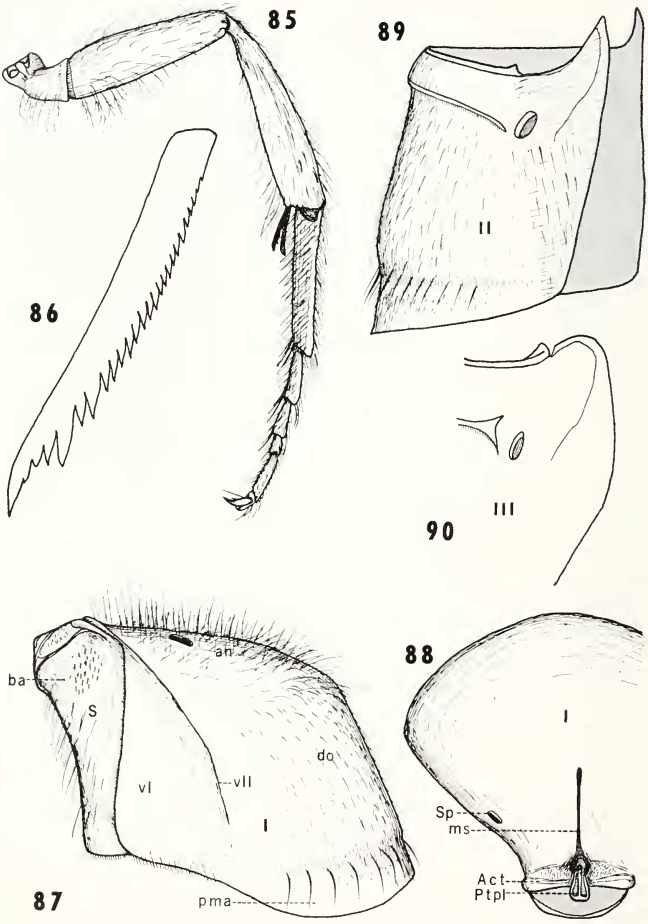
Figs. 64-70. Metasoma of *Pseudaugochloropsis graminea* female. 64, ventral view; 65, sternum II: 66, base of sternum III: 67, sternum IV: 68, sternum V: 69-70, sternum VI (69, ventral; 70, lateral). Acs—acrosternite; An—antecosta; Ap—sternal apodeme; dlS—dorsolateral area; dp—dorsal process of apodeme; Grd—gradulus; Poga—post gradular area; pma—posterior marginal area; Prga—pre-gradular area.



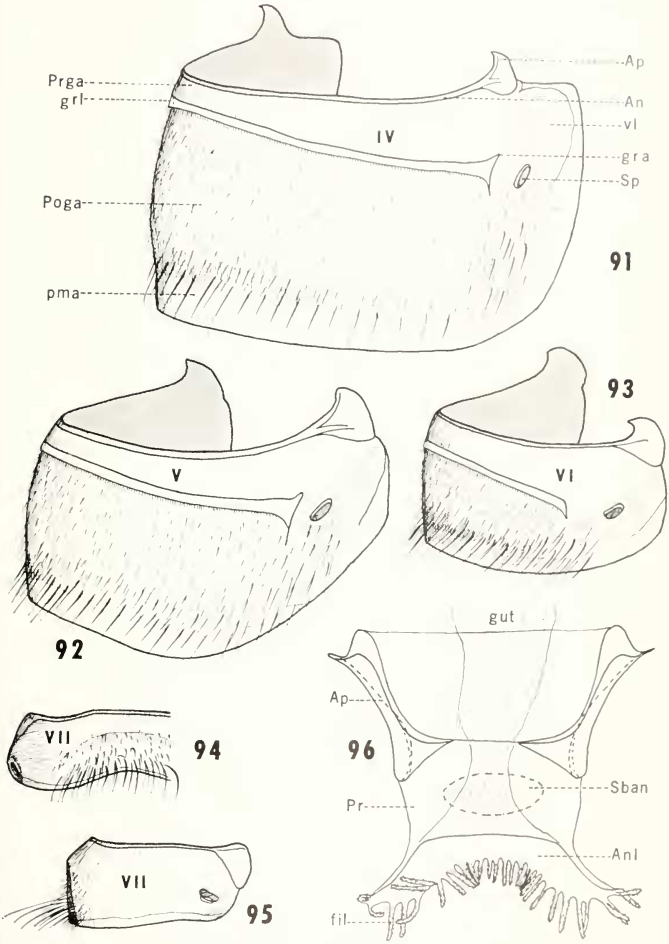
FIGS. **71-76.** Sting apparatus of *Pseudaugochloropsis graminea* female. **71,** sting apparatus, ventral view, flattened; **72,** spiracle plate; **73-74,** furca (73, dorsal; 74, lateral); **75,** first valvula; **76,** sting shaft. **bulb**—bulb of sting shaft; **Lan**—lancet; **Ob**—oblong plate; **Qd**—quadrate plate; **r**—rami; **Sh**—sheath; **Stng**—sting shaft; **Tri**—triangular plate; **Vlv**—valve.



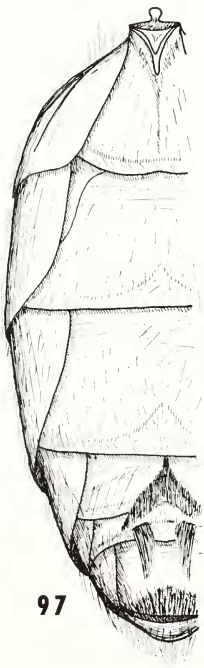
Figs. **77-84.** Head of *Pseudaugochloropsis graminea* male. **77**, front; **78**, ventral; **79**, antenna; **80**, postoccipital bridge; 81-82, labrum (81, anterior; 82, lateral); 83-84, mandible (83, outer; 84, anterior). **flhs**—posterior flange of hypostomal carina; **Pobr**—postoccipital bridge; **ptp**—posterior tentorial pit.

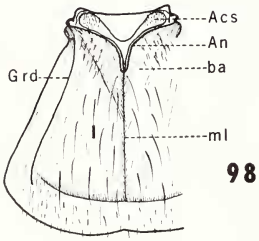


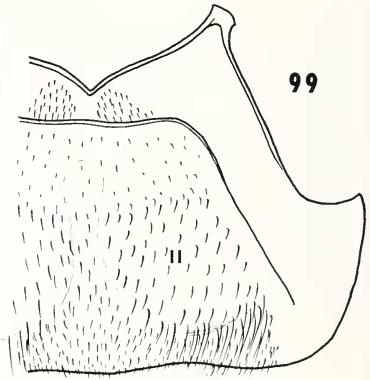
FIGS. 85-90. *Pseudaugochloropsis graminea* male. **85,** hind leg, posterior view; **86,** inner hind tibial spur; **87,** metasomal tergum and sternum I, lateral view; **88,** tergum I, anterior view; **89,** tergum II; **90,** tergum III. Hairs not shown on 88, 90. **Act**—petiole acrotergite; **an**—anterior surface of tergum I; **ba**—basal area of sternum I; **do**—dorsal surface of tergum I; **ms**—median sulcus; **pma**—posterior marginal area; **Ptpl**—median petiole plate; **S**—sternum I; **Sp**—spiracle; **vl**—ventro-lateral area of tergum I; **vll**—ventro-lateral line.

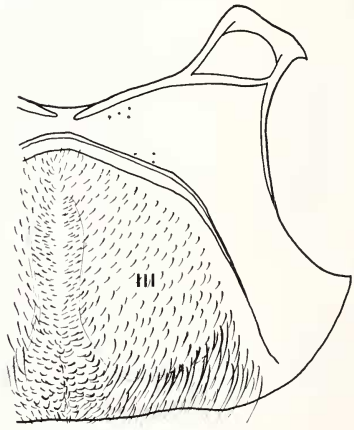


Figs. 91-96. Metasomal terga of *Pseudaugochlaropsis graminea* male. 91, tergum IV; 92, tergum V; 93, tergum VI; 94-95, tergum VII (94, posterior; 95, lateral); 96, tergum VIII and proctiger, dorsal view. An—antecosta; Anl—anal lip; Ap—tergal apodeme; fil—post-anal filaments; gra—gradular angle; grl—gradular lip; pma—posterior marginal area; Poga—post-gradular area; Pr—proctiger; Prga—pre-gradular area; Sban—subanal plate; Sp—spiracle; vl—ventro-lateral area.

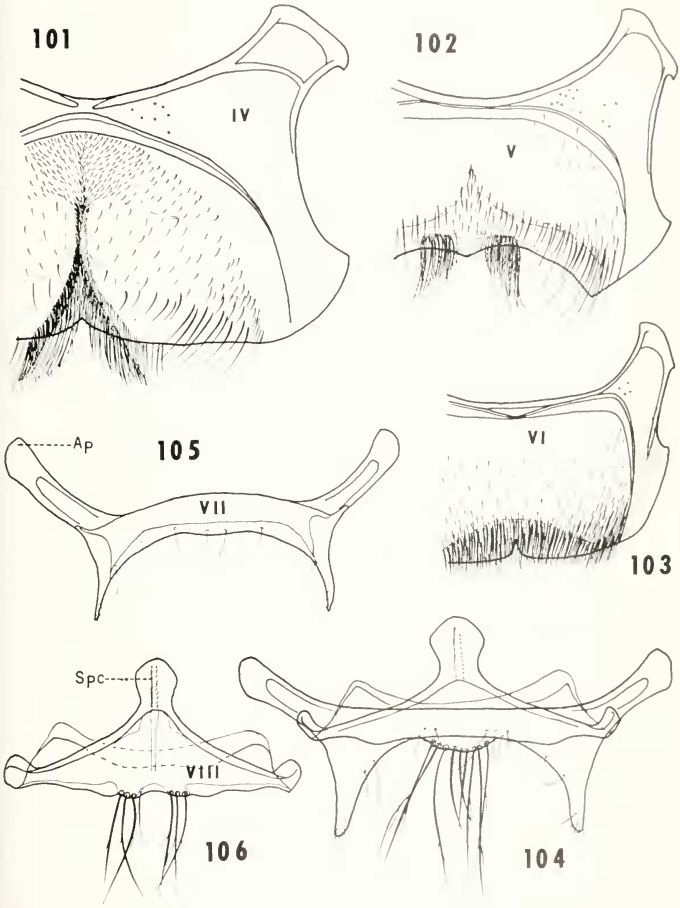




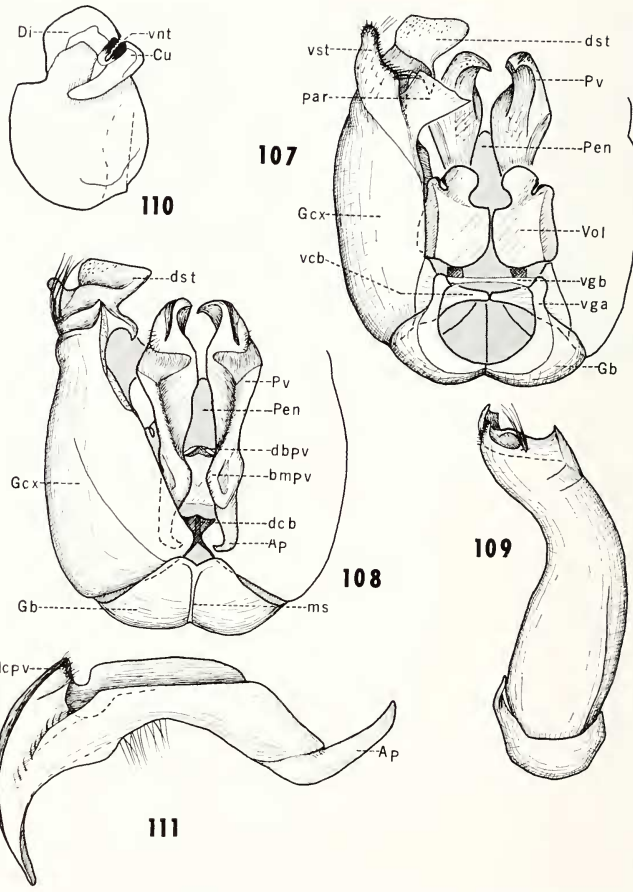




FIGS. 97-100. Metasoma of *Pseudaugochloropsis graminea* male. **97,** ventral view; **98,** sternum I; **99,** sternum II; **100,** sternum III. **Acs**—acrosternite; **An**—antecosta; **ba**—basal area; **Grd**—gradulus; **ml**—median line.



Figs. 101-106. Metasomal sterna of *Pseudaugochloropsis graminea* male. 101, sternum IV; 102, sternum V; 103, sternum VI; 104, sterna VII and VIII fused; 105, sternum VII; 106, sternum VIII. Ap—sternal apodeme; Spc—spiculum.



FIGS. **107-111.** Male genitalia of *Pseudaugochloropsis graminea*. **107,** ventral; **108,** dorsal; **109,** lateral; **110,** volsella, inner view; **111,** penis valve, lateral view. **Ap**—apodeme of penis valve; **bmpv**—basal median projection of penis valve; **Cu**—cuspis; **dbpv**—dorsal bridge of penis valves; **dcb**—dorsal gonocoxal bridge; **dcpv**—dorsal crest of penis valve; **Di**—digitus; **dst**—dorsal process of gonostylus; **Gb**—gonobase; **Gcx**—gonocoxite; **ms**—median sulcus; **par**—ventral parapenial lobe; **Pen**—penis; **Pv**—penis valve; **vcb**—ventral gonocoxal bridge; **vga**—ventral gonobasal arm; **vgb**—ventral gonobasal bridge; **vnt**—volsellar notch; **Vol**—volsella; **vst**—ventral process of gonostylus.

CHARACTERS EMPLOYED

From the almost infinite number of possible characters that might be described and measured on adult halictine bees, I have attempted to select characters for use in the systematic portion of this paper on the following bases: consistency within well-defined genera; discrete differences among well-defined genera; ease of observation on dry specimens; ease of description or illustration; and representation of all major sclerotized external parts and tagmata.

By using several specimens of each exemplar species, some characters could quickly be eliminated on account of excess variability within species. The exemplar study also provided an overall view of many possible characters from which a limited number were selected to be systematically examined in all the species studied. Characters were eliminated or used with qualifications if they appeared to vary more among species in well-defined genera than they did between genera.

Measurements were used sparingly, since measurements made on the type species of each genus only, or on only a few species per genus, tend to produce an appearance of quantitative rigor that would not be merited by the few species measured. The benefits to be accrued by standard errors of character states did not appear to justify the work that would have been involved, since adequate numbers of characters whose states differ qualitatively or by large degrees exist to separate genera. In the separation of species in several augochlorine genera, for example, *Augochlora,* a more quantitative approach would be justified and may prove to be absolutely necessary, especially to separate females, but that is beyond the scope of this paper.

Likewise, a number of possibly useful generic characters were excluded because of inaccessibility or difficulty of preparation. A further group of characters appeared to be potentially useful, but were very difficult to describe, an example being the form of the scopa.

While not all characters are equally useful in separating genera, and there is reason to believe that heavily weighting characters from one body tagma or one sex will change a classification (see Michener and Sokal, 1966), there also is no reason to believe that there is a particular set of "magic characters" which one must accurately discern and describe or the classification will be a failure. I make no claims to have found all possible or even all potentially useful characters, but this classification is presented with the belief that use of further characters of adult bees will not radically change the results.

A preliminary study (Eickwort, 1963) showed that many characters which were considered by previous authors, especially those prior to 1940, as existing in discrete qualitative states actually are continuous in their variation when a large number of species is examined. Excessive reliance on one or a few characters led some early authors (notably Schrottky) to unfortunate con-

clusions. For example, wing venation is less reliable than early studies would suggest and small differences in tibial spurs of females are not even reliable to separate species (see Eickwort and Fischer, 1963), although Schrottky used them to separate genera. While some characters used by early authors are utilized here, they are not given special weight.

As mentioned above, there are no ideal characters that *a priori* are totally adequate to separate genera. However, several characters are especially notable for best fitting the criteria outlined in the first paragraph of this section. These are the hidden male metasomal sterna, male genitalia, male metasomal sternum IV, epistomal lobe, distal proboscis structure, and the female hind tibial spur.

However, the classification presented in the next section is based on all the numbered characters listed below. Where one state of a character is found in a majority of genera, it is considered *normal* and so indicated. In the systematic section, characters which are *normal* in state are usually not mentioned at all or are described as being *normal,* the state described below thus indicated.

The female is considered first and all characters comparable in both sexes were measured or described from the female.

Female

Head. (1) **Epistomal sulcus.** The angle formed by the dorsal and lateral clypeo-genal sulci varies from nearly straight (Fig. 112) to acute, in the latter case the epistomal lobe protrudes deeply into the clypeus (Fig. 126). (2) The **clypeus** normally is beveled, with the lower half more coarsely and obscurely punctured and frequently not metallic. Also, normally the clypeus bears two clypeal teeth and a narrow marginal area, as in Fig. 1. Modifications include flattening of the clypeus, projection of the clypeus beyond the marginal area (Fig. 125), and spines (Fig. 115). (3) The **malar area** normally is very short (Fig. 3). In bees with very long heads, the malar area is prolonged (Figs. 136-137). (4) The **preoccipital ridge** varies from rounded to sharply carinate or flanged. (5) **Hypostoma:** The relative length and width of the hypostoma is estimated by measuring the median length (l) of the sclerotized floor of the hypostoma and dividing l by the maximum posterior width (w) of the proboscidial fossa, measured between the hypostomal carinae. These measurements are taken from the head when removed from the body and positioned as in Fig. 4 with the ventral border of the occiput just obscuring the dorsal border. (6) **Hypostomal bridge:** The extent of the hypostomal bridge varies from reaching the posterior margin of the hypostoma to nearly absent. It is estimated by measuring the "closed" length (c) of the hypostomal bridge suture (the stem of the Y) and dividing c by the length of the hypostoma (l), the head positioned as above. (7) **Hypostomal carina:** The anterior angle

is normally rounded; in one genus it is acutely pointed or produced. The posterior flange may be nearly flush with the posterior border of the head, positioned as above, or it may project beyond, as in Fig. 4. (8) The **inner orbit of the compound eye** varies from shallowly to deeply emarginate. The degree of emargination is estimated by positioning the head as in Fig. 1, and measuring the notch width (w) by drawing an imaginary line between the upper and lower inner extremities of the eye and measuring the perpendicular distance from this line to the notch, and dividing w by the total length (l) of the eye. In a few genera, the eyes are enlarged (Figs. 133-134). (9) The **eye hairs** normally are very short, visible only under a microscope; occasionally they are long and conspicuous. (10) The **ocelli** normally are slightly smaller in diameter than the antennal sockets (Fig. 1): occasionally they are enlarged (Fig. 130). (11) **Labrum:** The shape of the basal area is variable, as is the shape of the basal tubercle. Also variable is the shape of the distal process and keel; the keel in one genus is lacking. The labral fimbria are always present but may be placed on the anterior surface of the distal process, in from the lateral margins (Fig. 151). (12) The **mandible** normally bears a subapical tooth and resembles Fig. 11. In some species the mandible is elongate or broadened. The subapical tooth is produced apically in some species so that the mandible appears bidentate at its tip, and the outer posterior ridge may be swollen (Fig. 163). In species of other genera, the mandible bears supplementary teeth (Fig. 162). In one genus, the mandible is sickle-shaped (Fig. 168), the subapical tooth lacking, and it resembles the male mandible. (13) The **distal portion of the maxilla** varies considerably in length and width. The length and width of the combined stipes and galea are directly correlated with those of the prementum; only measurements of the prementum are given in the generic descriptions. The anterior conjunctival thickenings normally join the stipes near the base of the distal portion of the maxilla; occasionally the base of the galea is considerably distal to the base of the stipes and the thickenings join the stipes at that point. The apex of the galea is normally rounded and lobed (Fig. 176); in some species it is pointed and well sclerotized (Fig. 20). The inner strip is patterned with cuticular scale-like markings and contains variable numbers of long slender setae besides the few stout short setae which are always present. A *galeal comb* (Fig. 178) consisting of a single row of stout conspicuous setae may be present on the inner surface just below the inner strip; normally it is absent. (14) The **maxillary palpus** varies in length relative to the length of the distal portion of the maxilla, the ratio expressed as the extended length of the palpus (p) to the total length of the galea plus the stipes (M). When the palpus is relatively long, the distal segments are longer and more slender than the basal ones. In one genus, the palpi are greatly elongated (Fig. 182). (15) The **prementum** is normally triangular in cross-section and bears two well-sclero-

tized *premental thickenings* lining the anterior infolding (Fig. 170). In a few genera, the thickenings are absent and the anterior surface is flattened (Fig. 25). The anterior conjunctival thickenings normally join the prementum near its base; when the thickenings join the stipes far distal to the base of the distal portion of the maxilla, they also join the prementum far beyond its base. The prementum varies considerably in length and width; its length (pl) as measured from base to lateral posterior sclerotized extremities (just basal to the palpi) is estimated relative to the size of the bee by dividing pl by the maximum width of the head (W). The width of the prementum, measured across its distal sclerotized extremities (pw), is estimated relative to its length by dividing pw by pl. (16) The **salivary plate** normally is defined only by a very darkly pigmented U or V shaped brace (Fig. 173), the depth of the V varying with the length of the glossa. In species with a very long glossa, the plate is well sclerotized (Fig. 27) and no conspicuous U or V shaped brace is apparent. (17) The **glossa** varies considerably in length. When fully extended, its length (gl) is estimated relative to the length of the prementum by dividing gl by pl, and relative to the size of the bee by dividing pl by W (width of head). (18) **Labial palpus:** Normally segments 2 plus 3 are longer than 1; occasionally 1 is longer than 2 plus 3, and 1 is flattened in some species.

Mesosoma. (19) **Pronotum:** The dorsal surface is normally concave in lateral view (Fig. 30); in one genus it is convex. The lateral angle varies from rounded to strongly produced (Fig. 188). The dorsal ridge varies from rounded to strongly carinate or lamellate (Fig. 191), as does the lateral ridge. (20) The **mesoscutum** normally is broadly rounded anteriorly and the lip slightly overhangs the pronotum and is rounded (Figs. 30, 32). The mesoscutum may be narrowed anteriorly, and the mesoscutal lip may be produced to strongly overhang the pronotum and be sharply angulate or carinate (Fig. 188). (21) The **tegula** normally is semi-oval in outline (Fig. 34); in one genus its posterior inner angle is produced (Fig. 199). (22) The **basal area of the propodeum** is normally striate or rugose. Occasionally the basal area is sculptured in a fashion characteristic of a genus or species group, or the basal area may be devoid of all striation, being smooth or granular. (23) The **posterior surface of the propodeum** normally resembles Fig. 33, the lateral carinae diverging. The propodeum in some species is narrowed posteriorly, the lateral carinae little diverging. In one genus, the posterior surface is broadened ventrally, the lateral carinae being subparallel. In another genus, the lateral carinae are totally absent. Normally the propodeal pit is narrow although deep (Fig. 33), but it may be enclosed within a V-shaped notch. (24) The **apex of the marginal cell** of the forewing varies from acute (Fig. 201) to truncate and appendiculate (Fig. 37). (25) The **length of the marginal cell,** as measured by the distance from the apex of the stigma to the

apex of the cell (mc), is estimated relative to the length of the wing by dividing mc by the distance from the apex of the stigma to the wing tip (wl). Normally mc/wl ranges from .50 to .65; it is greater in cases where the marginal cell is elongate. The **distal hamuli** normally are irregularly spaced (Fig. 39), but in one genus they are very numerous and arranged in one long series. (26) **Tibial spines** at the apex of the hind tibia are normally absent or weakly formed; in some genera they are long and distinct, on the anterior or upper surfaces of the tibia. (27) The inner hind tibial spur, referred to simply as the **hind tibial spur,** has the inner row of serrations variously modified to form teeth or serrations of various forms. In some genera the spur is unmodified and resembles the outer spur. (28) The **scopa** is variously formed and normally present. In one genus it is absent. (29) The **basitibial plate** is narrowly or broadly rounded, well defined on all edges or not; in some genera it is comparatively short or, as in one genus, absent. (30) The **anterior basitarsal brush** may be well-defined, inconspicuous, or apparently absent. When it is absent or very poorly defined, the distal process is not produced.

Metasoma. (31) The **pseudopygidial area** of tergum V is normally clothed with fine, somewhat flattened setae, which may be sparse near the median slit. In some genera, the pseudopygidial area is clothed with darkly pigmented scale-like setae (Fig. 223). In one genus, the pseudopygidial area and the prepygidial fimbria are absent, the tergum resembling that of the male. (32) **Tergum VI** normally resembles Figs. 61 and 62. In some genera, the gradulus is lacking. (33) **Sternum I** is normally unmodified (Fig. 98); in one genus many species bear a median spine or protuberance (Fig. 225). (34) **Sterna IV, V,** and **VI** normally resemble Figs. 67-70. Graduli are normally lacking on sterna IV and V; in some genera they are present. In one genus, sterna IV and V resemble those of the male; in this genus sternum VI bears an unusually well-defined gradulus.

Male

Head. (35) The **antenna** varies in total length and relative lengths of the divisions. The scape (sc) is measured on its upper (longest) surface from the apex of the basal bulb to the tip; flagellomeres 1, 2, 3, and 10 (penultimate) are measured along their midlines (viewed laterally). Normally the antenna does not surpass the end of the mesosoma when extended caudally, and the flagellomeres increase in length progressively towards the apex. Normally the scape is rather long and slender (Fig. 79). When the antenna is very long, the scape is shorter, as in Fig. 181. Its length is measured relative to flagellomere 2 as the ratio sc/2. In some genera, the antenna is lengthened and may surpass the propodeum, and the relative lengths of the flagellomeres are greater when compared with the length of flagellomere 1. Normally the terminal flagellomere is beveled at its apex with the beveled surface shiny

and without setae; in one genus the terminal flagellomere is hooked. Normally the flagellomeres bear sensory plates and setae intermingled; in some species the plates are borne on special *plate areas* that do not bear setae. (36) The **labrum** varies similarly to that of the female, but the basal area always merges gradually into the distal process, and the distal process always lacks a keel.

Mesosoma. (37) The inner **hind tibial spur** is normally unmodified, although some serrations may be inconspicuously enlarged (Fig. 86). In one genus, the spur is pectinate with long teeth.

Metasoma. (38) The shape of the **metasoma** ranges from narrowly oval to quite narrow and elongate; in a few genera, it is petiolate, with the first segment decidedly narrower than the following and sterna I and II very long and narrow (Fig. 237). (39) **Tergum VII** varies in its outline as seen in lateral profile from gradually to abruptly convex and in the presence or absence of a gradulus. (40) **Proctiger:** Tergum VIII and the proctiger of tergum IX vary principally in the form of the anal lip, which may or may not be fringed with post-anal filaments, or otherwise modified. (41) **Sternum III** normally has the apical margin unmodified. Only the postgradular portion, visible without dissection, was systematically examined. In a few genera, the apical margin is modified. (42) **Sternum IV** normally (Fig. 251) is clothed with setae but without distinctive clumps of pubescence, the apical margin not modified, the gradulus either distant from the antecosta or touching it medially, and the antecosta either crossing the bases of the apodemes or not. In many genera, the sternum is modified in a variety of ways. (43) **Sternum V** normally (Fig. 252) resembles the normal state of sternum IV. It may also be modified in a variety of ways, although usually not as strikingly as sternum IV. (44) **Sternum VI** normally resembles Fig. 253, with the gradulus approaching or reaching the antecosta, the apical margin entire or medially notched, and with long strong setae apically on the postgradular area. Modifications usually involve the median postgradular area or the apex. (45) **Sterna VII** and **VIII** are fused laterally and usually dissected as a unit; they are illustrated both joined and separated for most genera. Sternum VII bears lateral apodemes; sternum VIII bears a median spiculum. Modifications of all parts of these sterna are significant generic or specific characters, and the posterior processes are particularly variable. (46) **Gonobase:** The ventral gonobasal bridge varies from membranous to thin and weakly formed to well sclerotized and wide (Fig. 325). The dorsal lobes vary from slight undulations to strong projections. (47) *Gonostylus:* The major variations of the gonoforceps are centered in the gonostyli. Both the ventral and dorsal processes are subject to an almost unlimited range of variation; the ventral process normally bears setae and the dorsal process is frequently membranous, at least in part. A small ventral *basal process* (Fig. 325) is frequently present

at the junction of the gonocoxite and gonostylus below the ventral process, and usually bears setae. (48) Important characteristics of the **penis valves** are the presence and form of a dorsal crest, presence or absence of a *ventral prong* (Fig. 379) or *ventral keel* (Fig. 334), and presence and form of lateral extensions and flanges, and dorsal depressions. The basal median projection and apodeme are relatively invariable. (49) The **volsellae** differ in size relative to the genitalia and the form of the digitus, especially its outline and external ridges.

Not included in the generic descriptions, but mentioned following them, are the general size range and color patterns of the included species. Color and size patterns are seldom strictly adhered to within a large or medium-sized genus, but definite trends become apparent when a long series of species are examined. "Small" bees are usually less than 5½ mm long, "large" bees are longer than about 9 mm, and "medium" sized bees are in between.

Two distinct types of green coloring are present in augochlorine bees, both of which have been called "metallic" by authors. I have reserved the term "metallic" for the rather dull greenish or bluish coloring which characterizes species of *Lasioglossum (Dialictus) (=Chloralictus)*, the common small sweat bees of North America. The majority of the augochlorine species are not of this color, but rather are much brighter, like most *Augochlora, Augochlorella,* and *Augochloropsis;* I refer to this color as "bright" or "brilliant" green (or blue). In some genera (for example, *Neocorynura*), many species are largely black, but bright green tints are usually visible on the head and margins of the mesoscutum.

The characters and their coded states employed in the numerical analysis are listed in Table 1 in Appendix 3. The coding technique is least effective in expressing the qualities of the male genitalia, since homologies of the gonostyli are difficult to ascertain or to code in a logical manner.

SYSTEMATIC TREATMENT

This section is introduced by keys which separate the Augochlorini from other American halictines and distinguish the genera and subgenera of the Augochlorini. The first couplet, distinguishing the Augochlorini, is the most difficult in the keys to use; a companion paper (Eickwort, in preparation) will more completely characterize the tribe.

The sexes are treated separately in the keys. As nearly as possible, only externally visible characters are used and the keys are therefore somewhat artificial. Males are more difficult than females to identify without dissection, since they usually lack such useful "key" characters as modified tibial spurs and basitibial plates; when in doubt, the genitalia should be compared with the figures.

KEYS TO GENERA AND SUBGENERA OF THE AUGOCHLORINI

Subfamily Halictinae

Females

Pseudopygidial area of metasomal tergum V slit medially; if pseudopygidial area absent, integument bright green and coarsely punctate; without scopa; outer veins of forewing always strong ..... Tribe Augochlorini
Pseudopygidial area entire; if area absent, integument not bright green; outer veins of forewing either strong or weakened ..... other Halictinae

Males

Pygidial plate of metasomal tergum VII absent; posterior margin of tergum VII not bent anteriorly; apex of metasomal sternum VIII with median spiculum ..... Tribe Augochlorini
Pygidial plate defined, at least on posterior margin; posterior margin of tergum VII bent anteriorly, thus visible in ventral view of bee; sternum VIII without spiculum ..... other Halictinae

Tribe Augochlorini

Females

1. Mouthparts very long and slender, as in Figs. 171 and 182; clypeus and supraclypeal area strongly produced (Figs. 129, 132); epistomal sulcus forming right angle 2
   Mouthparts not very long and slender; clypeus and supraclypeal area not strongly produced; epistomal sulcus variable 5
2(1). Maxillary palpi greatly lengthened (Fig. 182), reaching metasoma when mouthparts retracted into proboscidial fossa ..... *Ariphanarthra*
   Maxillary palpi not greatly lengthened 3
3(2). Eyes greatly enlarged, projecting above vertex and nearly reaching enlarged lateral ocelli and subantennal sulci (Fig. 130); basitibial plate not short, much surpassing apex of femur .... *Megaloptidia*
   Eyes not projecting above vertex; ocelli enlarged or not; basitibial plate very short, little surpassing apex of femur ..... *Megommation s. l.* 4
4(3). Ocelli enlarged (Fig. 128); hind tibial spur serrate ..... *Megommation (Megommation)*
   Ocelli not enlarged; hind tibial spur pectinate (Fig. 218) ..... *Megommation (Megaloptina)*
5(1). Hind tibial spur serrate, teeth shorter than wide, pointed or rounded 6
   Hind tibial spur pectinate, teeth longer than wide 14
6(5). Scopa and pseudopygidial area absent, integument coarsely punctate ..... *Temnosoma*
   Scopa and pseudopygidial area present 7
7(6). Hind tibial spur with rounded serrations (Figs. 214-216); preoccipital ridge sharply angled or carinate; epistomal sulcus variable 8
   Hind tibial spur with sharp serrations, as on outer spur, or with short narrow teeth (Figs. 206-207); preoccipital ridge sharply angled or rounded; epistomal sulcus forming obtuse angle 13

8(7). Epistomal sulcus forming acute angle, epistomal lobe protruding onto clypeus (Figs. 125-126); clypeus relatively flat, green almost to apex; anterior angle of hypostomal carina usually a sharp right angle or produced into spine; marginal cell truncate and usually appendiculate ..... *Augochlora s. l.* 9

Epistomal sulcus forming obtuse or right angle; clypeus beveled, area below angle not green; anterior angle of hypostomal carina rounded; marginal cell acute or very narrowly truncate 11

9(8). Mandible normal, subapical tooth not produced; pseudopygidial area of tergum V with long setae, not scale-like; sternum I usually normal, rarely with slight median ridge or tooth; basitibial plate usually narrowly rounded, occasionally broadly rounded; basal elevation of labrum suborbicular ..... *Augochlora (Oxystoglossella)*

Mandible bidentate (Fig. 163), subapical tooth and occasionally outer posterior ridge produced; pseudopygidial area of tergum V with scale-like setae (Fig. 223); sternum I frequently toothed or with median ridge, may be unarmed; basitibial plate broadly rounded; basal elevation of labrum transverse 10

10(9). Apex of clypeus prolonged beyond marginal area, rounded and slightly upturned, concealing half of labral basal area (Fig. 125) ..... *Augochlora (Mycterochlora)*

Apex of clypeus normal, not produced (Fig. 126) ..... *Augochlora (Augochlora)*

11(8). Epistomal sulcus forming obtuse angle (Fig. 124); hind tibial spur with basal area not raised (Fig. 215); basitibial plate poorly defined on anterior edge; preoccipital ridge carinate ..... *Ceratalictus*

Epistomal sulcus forming right or slightly obtuse angle; hind tibial spur with basal area raised (Fig. 214) or basal tooth high (Fig. 216); basitibial plate well defined on all edges; preoccipital ridge sharply angled or carinate 12

12(11). Hind tibial spur with few short rounded teeth, basal tooth largest (Fig. 216); basal area of propodeum striate basally, strongly granular; labrum as in Fig. 158; size small (about 5 mm) ..... *Pereirapis*

Hind tibial spur with rounded serrations, basal area raised, as in Fig. 214; basal area of propodeum not strongly granular; labrum usually as in Fig. 157, rarely as in *Pereirapis*; size usually larger than 5 mm ..... *Augochlorella*

13(7). Basal area of propodeum completely smooth or granular, no striae; preoccipital ridge gradually rounded; eyes deeply emarginate (Fig. 112) ..... *Corynura (Corynura)*

Basal area of propodeum roughened or with weak plicae basally; preoccipital ridge sharply angled; eyes moderately emarginate (Fig. 120) ..... *Paroxystoglossa*

14(5). Malar area as long as wide or longer; head greatly elongate 15

Malar area much shorter than wide; head not greatly elongate 16

15(14). Pronotum (Fig. 198) convex dorsally, lateral angle and lateral ridge absent; epistomal sulcus forming acute angle (Fig. 135); scutellum normal ..... *Chlerogella*

Pronotum normal; epistomal sulcus forming right angle (Figs. 136-137); scutellum produced into two large tubercles (?) ..... *Chlerogas**

16(14). Eyes and ocelli usually enlarged (Figs. 133-134); epistomal sulcus acutely angled, forming deep lobe; labrum and mandibles as in Figs. 159, 161 and 162 ..... *Megalopta*

Eyes and ocelli not enlarged; epistomal sulcus variously angled, not forming deep lobe; labrum and mandibles not as above 17

17(16). Tegula with inner posterior angle produced (Fig. 199); pronotal dorsal ridge lamellate, forming flange from lateral angle to lobe (Fig. 189); basitibial plate very short, extending barely past apex of femur (Fig. 204); labrum with distal process expanded and rounded, distal keel projecting beyond apex (Fig. 151) ..... *Augochloropsis s. l.* 18

Tegula not produced; pronotal dorsal ridge variable; basitibial plate not short, except in *Corynura (Callochlora);* labrum not as above, may be expanded distally 19

18(17). Basal area of propodeum deeply and regularly pitted or strongly striate basally, smooth apically ..... *Augochloropsis (Augochloropsis)*

Basal area of propodeum not as above, smooth, irregularly roughened, or with light plicae ..... *Augochloropsis (Paraugochloropsis)*

19(17). Pronotal dorsal ridge lamellate, forming flange from lateral angle to pronotal lobe; mesoscutum strongly produced over pronotum, usually forming carinate or lamellate flange 20

Pronotal dorsal ridge not lamellate; mesoscutum variable 21

20(19). Vertex swollen behind ocelli, clypeus usually armed with spines or median tubercle (Figs. 114-116); basal area of propodeum smooth, usually depressed transversely, bare; base of metasomal tergum I normal ..... *Rhinocorynura*

Vertex not swollen, clypeus not armed; basal area of propodeum short, striate, completely covered with short dense pile; tergum I with basal enclosure formed by dense plumose hairs near petiole, usually containing large mites ..... *Thectochlora*

21(19). Pronotal lateral angle produced, strongly carinate anteriorly and laterally; dorsal ridge not carinate behind lateral angle (Figs. 184-185); lateral ridge carinate; mesoscutum slightly produced over pronotum, low and sharply angled; preoccipital ridge rounded 22

Pronotal lateral angle not strongly carinate anteriorly; if produced, dorsal ridge carinate; lateral ridge variable; mesoscutum and preoccipital ridge variable 23

22(21). Marginal cell of forewing very long, extending about 4/5 distance from apex of stigma to apex of wing; stigma enlarged; pronotum as in Fig. 184 ..... *Corynurella*

Marginal cell of forewing of normal length, extending about 3/5 distance from apex of stigma to apex of wing; stigma not enlarged; pronotum as in Fig. 185 ..... *Rhectomia*

* The female is unknown. Characters hypothesized from males.

23(21). Epistomal sulcus forming right or slightly acute angle 24
Epistomal sulcus forming obtuse angle 27

24(23). Preoccipital ridge rounded, vertex produced to rounded ridge above ocelli (Figs. 1, 3); galea of maxilla with apex pointed, well-sclerotized (Fig. 21); basal elevation of labrum with apical surface flattened, rimmed (Figs. 7-8) ..... *Pseudaugochloropsis*
Preoccipital ridge sharply angled or carinate, vertex not produced; galea normal, with apical lobe; labrum not as described above 25

25(24). Basitibial plate well-defined posteriorly, obsolescent anteriorly (Fig. 203); hind tibial spur with few teeth (Fig. 212); pronotal lateral angle not produced, forming obtuse angle; eye hair short; restricted to Andean region ..... *Andinaugochlora*
Basitibial plate well-defined on all edges *or* tibial spur closely pectinate; pronotal lateral angle frequently produced, occasionally obtuse; eye hair frequently long; widespread ..... *Caenaugochlora s. l.* 26

26(25). Basitibial plate well-defined on all edges; tibial spur not closely pectinate; eye hair frequently long ..... *Caenaugochlora (Caenaugochlora)*
Basitibial plate obsolescent anteriorly; tibial spur closely pectinate, over 10 teeth (Fig. 217); eye hair short ..... *Caenaugochlora (Ctenaugochlora)*

27(23). Preoccipital ridge carinate or lamellate; mesoscutum *usually* narrowed anteriorly and mesoscutal lip *usually* narrow, high, projecting forward and sharply angled (Fig. 187); pronotal lateral angle *usually* strongly produced, lateral ridge carinate or lamellate; propodeum *usually* narrowed posteriorly, lateral carinae little diverging ..... *Neocorynura s. l.* 28
Preoccipital ridge rounded; mesoscutum not narrowed anteriorly, mesoscutal lip *usually* not high or narrow, pronotal lateral angle *usually* not produced; pronotal lateral ridge sharply angled or rounded; propodeum not narrowed posteriorly 29

28(27). Preoccipital ridge strongly lamellate, flange recurving over gena; pronotal lateral ridge strongly lamellate; known from Bolivia and Peru ..... *Neocorynura (Neocorynuroides)*
Preoccipital ridge and pronotal lateral ridge carinate; widespread ..... *Neocorynura (Neocorynura)*

29(27). Head, mesosoma and metasoma brilliant green or orange-green; propodeal basal area weakly striate 30
Head and mesosoma dull metallic green or blue, black or brownish; metasoma variously colored but not brilliant green; propodeal basal area smooth or roughened 31

30(29). Eyes with long hair; basitibial plate (Fig. 202) defined only posteriorly, very short ..... *Corynura (Callochlora)*
Eyes with short hair; basitibial plate well-defined on all edges, of normal length ..... *Augochlorodes*

31(30). Basal area of propodeum roughened; bee dull metallic; size small (5-6 mm) ..... *Halictillus*
Basal area of propodeum smooth or granular; bee variously colored, size usually larger than 6 mm ..... *Corynura (Corynura)*

Males

1. Mouthparts very long and slender, as in Figs. 171 and 182; clypeus and supraclypeal area strongly produced (Figs. 129, 132); epistomal sulcus forming right angle 2
Mouthparts not very long and slender; clypeus and supraclypeal area not strongly produced; epistomal sulcus variable 5

2(1). Maxillary palpi greatly lengthened (Fig. 182), reaching metasoma when mouthparts retracted into proboscidial fossa ..... *Ariphanarthra*
Maxillary palpi not greatly lengthened 3

3(2). Eyes greatly enlarged, projecting above vertex and nearly reaching enlarged lateral ocelli and subantennal sulci (Fig. 130); metasomal sternum IV bilobed with deep median notch, lobes strongly pilose ..... *Megaloptidia*
Eyes not projecting above vertex; ocelli enlarged or not; metasomal sternum IV not bilobed, with row or rows of strong modified setae laterally bordering gradulus (Figs. 262-263) ..... *Megommation s. l.* 4

4(3). Ocelli enlarged (Fig. 128); propodeum without dense patches of pubescence; metasomal sternum V strongly emarginate ..... *Megommation (Megommation)*
Ocelli not enlarged; lateral surfaces of propodeum with patches of dense pubescence near spiracles; metasomal sternum V weakly emarginate ..... *Megommation (Megaloptina)*

5(1). Malar area as long as wide or longer; head greatly elongate 6
Malar area much shorter than wide; head not greatly elongate 7

6(5). Pronotum (Fig. 198) convex dorsally, lateral angle and lateral ridge absent; epistomal sulcus forming acute angle; scutellum normal (?) ..... *Chlerogella**
Pronotum normal; epistomal sulcus forming right angle (Figs. 136-137); scutellum produced into two large tubercles .. *Chlerogas*

7(5). Tegula with inner posterior angle produced (Fig. 199); pronotal dorsal ridge lamellate, forming flange from lateral angle to lobe (Fig. 189); metasomal sternum IV with lateral appendages, usually hidden or partly projecting from beneath tergum IV, sternum posteriorly emarginate with median point (Figs. 243-244) [lateral appendages nearly absent in a few species (Fig. 245)]; posterior margins of metasomal terga I and II frequently each with a row of strong setae (Fig. 224); marginal cell of forewing truncate ..... *Augochloropsis s. l.* 8
Tegula not produced; pronotal dorsal ridge variable; metasomal sternum IV variable; posterior margins of metasomal terga without rows of strong setae; marginal cell of forewing variable 9

8(7). Metasomal sternum V with apical margin notched, centrally with long curved setae; sternum VI with wide apical flanges projecting beyond posterior border (Fig. 246); distal process of labrum truncate or notched apically; ventral gonostylus bearing row of strong, flattened, modified setae at apex (Figs. 362-363) ..... *Augochloropsis (Augochloropsis)*

* The male is unknown. Characters hypothesized from female.

Metasomal sternum V with apical margin entire, setae not modified; sternum VI with apical flanges little developed (Fig. 247); distal process of labrum rounded (Fig. 152); ventral gonostylus bearing dense unmodified setae at apex (Fig. 366) ..... *Augochloropsis (Paraugochloropsis)*

9(7). Metasomal sternum IV with conspicuous apical or median tufts of specialized setae or strong cuticular ridges and depressions 10

Metasomal sternum IV usually not modified; apical margin at most emarginate or with posterior lateral projections (Figs. 248-249), usually hidden 15

10(9). Eyes and ocelli usually enlarged (Fig. 133); metasomal sternum III bilobed (Fig. 264); sternum IV with posterior margin notched laterally, bilobed medially, and with median flap (Fig. 265); pronotal dorsal ridge (Figs. 195-196) rounded and narrow, anterior edge of lateral angle and lateral ridge carinate ..... *Megalopta*

Eyes and ocelli not enlarged; metasomal sternum III not strongly bilobed, may be medially emarginate; sternum IV not as above; pronotal dorsal ridge carinate or lamellate, lateral angle not strongly carinate on anterior margin, lateral ridge variable 11

11(10). Pronotal dorsal ridge and mesoscutal lip lamellate, forming flange (Fig. 191); antenna long, scape less than 1.5 times length of flagellomere 2; metasomal sternum IV (Fig. 249) produced into caudally directed processes which bear strong setae (usually hidden), posterior margin depressed and truncate, median patch of short erect stout setae; sternum V emarginate, with long plumose pubescence ..... *Thectochlora*

Pronotum and mesoscutum not lamellate; antenna of variable length, scape more than 1.5 times length of flagellomere 2; metasomal sterna IV and V not as above 12

12(11). Epistomal sulcus forming obtuse angle; metasomal sternum IV without distinctive median or posterior setal patches, with posterior margin emarginate and centrally depressed and shiny, or with shiny median apical depression bordered by sharp ridges (Fig. 238); sternum V with median shiny depression usually bordered by strong ridges (Fig. 239) ..... *Paroxystoglossa*

Epistomal sulcus forming right angle; metasomal sternum IV with distinctive median or apical setal patches; sternum V variable 13

13(12). Terminal antennal flagellomere hooked (Fig. 79); preoccipital ridge rounded ..... *Pseudaugochloropsis*

Terminal antennal flagellomere not hooked; preoccipital ridge sharply angled or carinate ..... *Caenaugochlora s. l.* 14

14(13). Metasomal sternum IV (Fig. 256) bearing distinctive setal clumps on raised tubercles to either side of apical median depression; eyes often bear long hairs ..... *Caenaugochlora (Caenaugochlora)*

Metasomal sternum IV (Fig. 257) with V-shaped patch of setae bordering slight median depression, eyes with short hairs ..... *Caenaugochlora (Ctenaugochlora)*

15(9). Body very coarsely punctate; metasomal terga I to III strongly depressed basally; antenna short, as in Fig. 180; metasomal tergum VII prolonged apically and bilobed (Figs. 230-231) ..... *Temnosoma*

Body not very coarsely punctate; metasomal terga not strongly depressed; antenna not as in Fig. 180, length variable; metasomal tergum VII not prolonged or bilobed 16

16(15). Pronotal dorsal ridge lamellate, forming flange from lateral angle to lobe (Figs. 186, 191); mesoscutum strongly produced over pronotum, lip usually carinate or lamellate 17

Pronotal dorsal ridge not lamellate and forming flange, mesoscutum variable but lip not carinate or lamellate 18

17(16). Vertex swollen above ocelli; basal area of propodeum smooth; metasomal sterna IV and V unmodified; scape more than twice length of flagellomere 2 ..... *Rhinocorynura*

Vertex not swollen; basal area of propodeum striate; metasomal sternum IV (Fig. 249) produced into caudally directed processes bearing strong setae (usually hidden), posterior margin depressed and truncate, median patch of short erect stout setae; sternum V emarginate, with long plumose pubescence; scape less than 1.5 times as long as flagellomere 2 ..... *Thectochlora*

18(16). Antenna very long, scape usually shorter than flagellomere 2, never more than 1.25 times length of 2; flagellomere 2 usually subequal to or longer than 10; preoccipital ridge rounded 19

Antenna of variable length, but scape over 1.25 times length of flagellomere 2; flagellomere 2 usually shorter than 10; preoccipital ridge variable 21

19(18). Metasoma elongate, not petiolate; size small (about 5-6 mm); color metallic blue-green; genitalia as in Figs. 331 to 334 ..... *Halictillus*

Metasoma petiolate, segments I and II long and narrow, as in Fig. 237; if not, color usually bright green or orange-green; size usually larger than 6 mm; genitalia as in Figs. 325 to 330 ..... *Corynura s. l.* 20

20(19). Integument bright green or orange-green; hairs on eyes long; metasoma elongate but not distinctly petiolate ..... *Corynura (Callochlora)*

Integument not bright green; mesosoma dull metallic, black, or brown; hairs on eyes short; metasoma usually distinctly petiolate ..... *Corynura (Corynura)*

21(18). Pronotal lateral angle produced and strongly carinate anteriorly and laterally (Figs. 184-185), dorsal ridge posterior to lateral angle not carinate, lateral ridge carinate; mesoscutum slightly produced over pronotum, low and sharply angled; preoccipital ridge rounded 22

Pronotal lateral angle not strongly carinate anteriorly, if produced, dorsal ridge carinate, lateral ridge variable; mesoscutum and preoccipital ridge variable 23

22(21). Marginal cell of forewing very long, extending about 0.8 distance from apex of stigma to apex of wing; stigma enlarged; pronotum as in Fig. 184 ..... *Corynurella*

Marginal cell of forewing normal, extending about 0.6 distance from apex of stigma to apex of wing; stigma not enlarged; pronotum as in Fig. 185 ..... *Rhectomia**

23(21). Preoccipital ridge rounded; metasomal sternum IV (Fig. 248) emarginate with lateral process bearing low setae, processes usually hidden by tergum IV with setae protruding from beneath apical margin of tergum; inner hind tibial spur with long serrations; body shiny green, weakly punctate; basal area of propodeum smooth with fine short basal plicae; known only from southern Brazil ..... *Augochlorodes*

Preoccipital ridge sharply angled or carinate; metasomal sternum IV not as above; inner hind tibial spur normal, with short serrations; body variously colored and punctured 24

24(23). Epistomal sulcus forming obtuse angle 25

Epistomal sulcus forming acute or right angle 28

25(24). Antenna reaching about to scutellum, scape more than 2.5 times length of flagellomere 2, 2 subequal to 1; mesoscutum not narrowed and not produced over pronotum; integument bright green, tibiae and tarsi orange. (Compare with *Augochlorella* and *Pereirapis*.) ..... *Ceratalictus*

Antenna long, frequently surpassing propodeum, scape less than 2.5 times length of flagellomere 2, 2 longer than 1 and usually more than 1.5 times length of 1; mesoscutum usually narrowed and produced over pronotum; color variable 26

26(25). Metasomal sterna IV and V depressed medially and shiny; posterior margin of IV broadly emarginate; venter of head and mesosoma and lower surfaces of legs clothed with long plumose pubescence; metasoma not petiolate; known from southern Brazil to Argentina ..... *Paroxystoglossa*

Metasomal sterna IV and V not modified; venter without long plumose pubescence; metasoma frequently petiolate (Fig. 222); sterna I and II usually very long and narrow (Fig. 237); widespread. (Compare with *Andinaugochlora*.) ..... *Neocorynura s. l.* 27

27(26). Preoccipital ridge and lateral ridge of pronotum carinate, not strongly lamellate; widespread ..... *Neocorynura (Neocorynura)*

Preoccipital ridge lamellate, flange recurving over gena; lateral ridge of pronotum strongly lamellate; known from Bolivia and Peru ..... *Neocorynura (Neocorynuroides)*

28(24). Antenna very long, surpassing propodeum; scape twice or less times length of flagellomere 2; flagellum with plate areas containing only sensory plate-organs, these areas without setae; metasomal sternum VI (Fig. 241) strongly notched with deep concavities to either side of median notch; restricted to Andean region. (Compare with *Neocorynura*) ..... *Andinaugochlora*

* Not known from male sex. Characters hypothesized from female.

Antenna of moderate length, usually not surpassing propodeum; scape over 3 times length of flagellomere 2, flagellum without specialized plate areas (antenna rarely long and with plate areas in *Augochlora*); metasomal sternum VI without deep concavities to either side of median notch; widespread 29

29(28). Epistomal sulcus forming acute angle, epistomal lobe protruding into clypeus; marginal cell of forewing truncate, usually appendiculate ..... *Augochlora s. l.* 30

Epistomal sulcus forming right angle; marginal cell of forewing acute, rarely narrowly truncate. (Compare with *Ceratalictus*.) 32

30(29). Metasomal sterna V and VI with strong median apical depressions, bordered by stiff setae on VI and by median ridge at base of depression on V; posterior margin of tergum VII flanged outwards, appearing carinate .... *Augochlora (Mycterochlora)*

Metasomal sterna V and VI and tergum VII not modified, not as described above 31

31(30). Lateral ridge bordering ventral gonostylus (Fig. 377) with short setae ..... *Augochlora (Augochlora)*

Lateral ridge bordering ventral gonostylus (Fig. 381) with long setae, surpassing gonostylus ..... *Augochlora (Oxystoglossella)*

32(29). Metasomal sternum IV broadly emarginate posteriorly, laterally bearing long modified setae which are usually hidden (Fig. 254); size small, about 5 mm; genitalia as in Figs. 393-396 ..... *Pereirapis*

Metasomal sternum IV not broadly emarginate, without long lateral setae; size usually larger than 5 mm; genitalia (Figs. 384-387) with inner lobe of ventral gonostylus bearing marginal row of flattened setae ..... *Augochlorella*

Genus **Corynura** Spinola

Female

HEAD. (Fig. 112). (1) Epistomal sulcus forming obtuse angle. (4) *Preoccipital ridge gradually rounded.* (5, 6) *Hypostomal floor very short and broad, width subequal to or greater than length,* l/w = .63 to 1.04, c/l = 0 to .59 (7 spp.). (7) Posterior flange projects beyond occiput. (8) Inner orbit of compound eye strongly emarginate, w/l = .127 to .158 (7 spp.)*. (11) Labrum (Figs. 139-140) with distal process broadly triangular, usually as wide as and as long as or longer than basal area. Basal elevation usually rounded and transverse, strongly protuberant. Distal keel normal or flattened apically (Fig. 140). (13) *Distal portion of maxilla short and broad* (Fig. 177), *with base of galea far distal to base of stipes, at junction of anterior conjunctival thickenings. Well-formed galeal comb present* (Fig. 178). Inner strip with broad scale-like cuticular markings, no long setae. (14) Maxillary palpus p/M = .42 to .64 (11 spp.). (15) Prementum normal (Fig. 169) with anterior conjunctival thickenings far distal to its base, pl/W = .50 to .61, pw/pl = .24 to .32 (11 spp.). (16) Salivary plate normal, broad U-shaped

brace (Fig. 173). (17) *Glossa short,* gl/pl = .28 to .41, gl/W = .16 to .24 (11 spp.).

MESOSOMA. (19) Pronotal dorsal ridge carinate, often weakly so. Lateral angle usually not produced, obtuse, occasionally produced to an acute angle (Fig. 183). Lateral ridge rounded, sharp when lateral angle produced. (20) Mesoscutum not narrowed anteriorly, lip rounded*. (23) Propodeal pit enclosed within V-shaped notch arising at junction with posterior marginal area. (24, 25) Marginal cell of forewing acute, mc/wl = .55 to .63 (6 spp.). (26) Long tibial spine or spines present. (30) Anterior basitarsal brush well-defined.

METASOMA. (31) Tergum V may bear short acrotergite above antecosta. Sterna and terga otherwise normal*.

Male

HEAD. (35) *Antenna* (Fig. 183) *very long, scape shorter than or subequal to flagellomere 2, 2 longer than 10**; sc/2 = .79 to 1.18, 2/1 = 2.31 to 3.25, 3/1 = 2.28 to 3.14, 10/1 = 2.14 to 2.86 (5 spp.). Plate areas usually present, rarely absent. (36) Labrum (Fig. 142) short and transverse, distal process absent or nearly so, basal elevation extending across basal area, not notched.

METASOMA. (38) *Metasoma long, narrow, and petiolate, sterna I and II very long and narrow,* similar to *Neocorynura* (Fig. 237). (39) Tergum VII gradually convex apically, gradulus absent or weakly defined. (40) Anal lip of proctiger without post-anal filaments. (42-44) Sterna IV to VI normal, apex of VI weakly notched. (45) Posterior margins of sterna VII and VIII (Figs. 268-273) usually variously produced medially, usually bearing setae. Sternum VIII joins VII laterally at apices of apodemes. Spiculum broad. (46) Gonobase (Figs. 325-330) with broad ventral bridge, dorsal lobes weakly formed. (47) Ventral gonostylus projecting from strong lateral ridge, seta-bearing surface directed cephalad and scarcely visible from ventral view, additional ventrally facing seta-bearing surface more or less developed. Basal process of gonostylus present. Dorsal gonostylus a simple ridge. (48) Penis valve (Fig. 327) without dorsal crest, with slight ventral keel, medial edge slightly expanded, with longitudinal dorsal groove. (49) Volsella (Fig. 328) with inner posterior angle variously produced.

*Exceptions

In two species with broad heads, the eyes are less emarginate, w/l = .096 to .107. In *Corynura chilensis* (Spinola), which has strongly protuberant pronotal lateral angles (Fig. 183), the mesoscutal lip is high, although the mesoscutum is not narrowed anteriorly. In two species examined, the pseudopygidial area bears scale-like setae bordering the median slit. In *Corynura (Callochlora) prothysteres* (Vachal), flagellomere 2 is shorter than 10, 2/1 =

1.31, 3/1 = 1.53, and 10/1 = 2.44, although the antennae are very long and bear plate areas.

Corynura is a moderate-sized genus of Chilean and Argentinian bees, with a few species reaching southern Brazil and Bolivia. It is composed of two subgenera, appearing quite different at first glance but quite similar in most generic characters.

Subgenus **Corynura** Spinola

Corynura Spinola, 1851, Historia fisica y politica de Chile, Zoologia, 6:296. (Type species: *Corynura gayi* Spinola, 1851, designated by Alfken, 1926).

Corynogaster Sichel, 1867, Hymenoptera Fossosia et Mellifera. Supplement to H. de Saussure, Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859. Zoologischer Theil. vol. 2: Hymenoptera:146. *lapsus* for *Corynura*?

Rhopalictus Sichel, 1867, Hymenoptera Fossoria et Mellifera. Supplement to H. de Saussure, Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859. Zoologischer Theil. vol. 2: Hymenoptera:146. (Type species: *Corynura flavofasciata* Spinola, 1851, designated by Alfken, 1926).

Female

(9) Compound eye with hairs of normal length. (22) Basal area of propodeum completely smooth or granular, no striae. (27) Hind tibial spur usually with sharp serrations (Fig. 206) as on outer spur or pectinate with short teeth (Fig. 207), rarely with long teeth. (29) Basitibial plate well-defined on all edges, narrowly rounded.

Male

(47) Basal process of gonostylus with setae.

Species of *Corynura s. s.* are black or dull metallic bees, occasionally with a red metasoma, never bright green, small to medium sized. The long petiolate abdomen and very long antennae of the male distinguish *Corynura* from all other halictines within its range except *Neocorynura,* which has a carinate preoccipital ridge and antennae with the scape longer than flagellomere 2. Females of *Corynura* resemble species of *Halictus* or *Lasioglossum s. l.* more than they do most augochlorine genera, due to their color. They are most likely to be confused with *Ruizantheda,* a relative of *Agapostemon* with long-haired compound eyes and tibial spurs with lamellate teeth.

Corynura was the first described augochlorine genus. Spinola (1851) named two species, *Corynura gayi* and *C. flavofasciata,* from a wasp female and halictine males and placed the genus near the Thynnidae. However, the generic description dealt primarily with the males and the name has usually been used for bees. Sichel (1867) correctly associated a halictine female with the male of *C. flavofasciata* and named *Rhopalictus* for the halictines in Spinola's *Corynura,* assuming that *Corynura* should be reserved for wasps. He mistakenly used *Corynogaster* instead of *Corynura* to refer to Spinola's genus, and did not intend to create a genus by that name, as pointed out by Herbst (1917).

Until recently, *Corynura* was used also to refer to species correctly placed in *Neocorynura*. Alfken (1926) published a revision of the Chilean *Corynura* and an extensive discussion and historical summary of the genus. He quite clearly recognized that *Corynura* is distinct from species now placed in *Neocorynura*, but unfortunately placed *Corynura chilensis* (Spinola) (= *C. flavofasciata* Spinola), the type species of *Rhopalictus*, with the latter group and consequently called this group *Rhopalictus* instead of *Neocorynura*, which he considered a synonym of *Rhopalictus*. Alfken later (1931) published a correction to his description of *Corynura* and a revised key to the species.

Sandhouse (1943) mistakenly thought that *Corynura* was described as a subgenus of *Halictus* by Spinola and designated *Halictus gayi* Spinola as type species for *Corynura*, *Corynogaster*, and *Manuelia*. The former two designations are invalid since *Corynura gayi* Spinola, not *Halictus gayi* Spinola, was included in *Corynura* by Spinola. *Halictus gayi* is a ceratinine bee, to which *Manuelia* correctly refers (Vachal, 1905).

Moure (1944a) listed the complete synonymy of *Corynura*, including all citations of species of *Corynura*, and eliminated those referring to species of *Neocorynura*.

Well known species of *Corynura s. s.* include *C. chilensis* (Spinola), *C. corynogaster* (Spinola), and *C. rubella* (Haliday).

Subgenus **Callochlora** Moure, new status

Callochlora Moure, 1964, J. Kansas Entomol. Soc. 37:269. (Type species: *Halictus chloris* Spinola, 1851, original designation).

Female

(9) *Compound eyes with long hair.* (22) Basal area of propodeum with striae. (27) Hind tibial spur (Fig. 208) pectinate, with long teeth. (29) Basitibial plate (Fig. 202) defined only posteriorly, very short.

Male

(47) Basal process of gonostylus without setae (Fig. 329).

Species of *Callochlora* are bright green or bright coppery green and thus appear quite different from *Corynura s. s.* The male metasoma is elongate but not so distinctly petiolate as in *Corynura s. s.* The long-haired eyes and obtuse epistomal lobes distinguish its species from other bright green augochlorine bees.

Moure (1964) described *Callochlora* for two species, *C. chloris* (Spinola) and *C. prothysteres* (Vachal). He illustrated the genitalia of *C. chloris*, but reversed the captions for it and *Ruizantheda*. Figure 3 of Moure (1964), labeled *C. chloris*, actually illustrates the genitalia of *R. proxima* (Spinola) while Fig. 2 actually illustrates *C. chloris*; Fig. 1, labeled *R. proxima*, actually illustrates *R. mutabilis* (Spinola).

Genus **Halictillus** Moure

Halictillus Moure, 1947, Publ. avulsas Mus. paranaense no. 3:7. (Type species: *Chloralictus loureiroi* Moure, 1941, monobasic and original designation.)

Female

HEAD (Fig. 113). (1) Epistomal sulcus forming obtuse angle. (4) Preoccipital ridge rounded. (5, 6) Hypostomal floor slightly longer than wide, l/w = 1.07 to 1.16, c/l = .25 to .26 (2 spp.). (8) Inner orbit of compound eye moderately emarginate, w/l = .085 to .097 (3 spp.). (11) Labrum (Fig. 141) with distal process narrowly triangular, sometimes protruding just below basal area to lateral margins of basal area; basal elevation suborbicular, rounded and protuberant. (13) *Distal portion of maxilla with base of galea far distal to base of stipes, at junction of anterior conjunctival thickenings,* as in *Corynura* but longer and narrower. *Galea comb present, of 6 or more teeth,* inner strip with broad scale-like markings, no long setae. (14) Maxillary palpus long, p/M = .41 to .50 (3 spp.). (15) Prementum as in *Corynura,* anterior conjunctival thickenings joining prementum far distal to its base, pl/W = .56 to .70, pw/pl = .21 to .25 (3 spp.). (16) Salivary plate normal. (17) Glossa rather short, less than half length of prementum, gl/pl = .31 to .44, gl/w = .20 to .31 (3 spp.).

MESOSOMA. (19) Pronotal lateral angle obtuse, not produced; dorsal ridge carinate, lateral ridge rounded. (20) Mesoscutum not narrowed anteriorly, lip rounded. (22) Basal area of propodeum roughened, posterior edge smooth or granular. (23) Propodeal pit enclosed within V-shaped notch arising at junction with posterior marginal area. (24, 25) Marginal cell acute, mc/wl = .47 to .57 (2 spp.). (26) Long tibial spines present. (27) *Hind tibial spur* (Fig. 209) *pectinate, all teeth long.* (29) Basitibial plate poorly defined on anterior edge, well defined posteriorly, narrowly rounded. (30) Anterior basitarsal brush well-defined.

Male

HEAD. (35) *Antenna very long, surpassing propodeum, plate areas present, scape shorter than or subequal to flagellomere 2, 2 longer than 10, as in Corynura:* sc/2 = .90 to .91, 2/1 = 2.75 to 3.70, 3/1 = 2.38 to 3.33, 10/1 = 2.18 to 3.03 (2 spp.). (36) Labrum short and transverse, distal process absent or nearly so, basal elevation extending across basal area, not notched, as in *Corynura* (Fig. 142).

METASOMA. (38) Metasoma elongate but not petiolate. (39) Tergum VII abruptly convex, gradulus absent. (40) Anal lip of proctiger without postanal filaments. (42-44) Sterna IV-VI normal, sternum VI not notched. (45) Sternum VII broadly produced posteriorly to truncate projection bearing short setae; apodemes slightly recurved. Sternum VIII produced posteriorly into narrow median lobe bearing strong setae; laterally joining VII on posterior edge of apices of apodemes. Spiculum broad (Figs. 274-276).

(46) Gonobase (Figs. 331-334) with broad ventral bridge, dorsal lobes slightly projecting over gonocoxites. (47) Ventral gonostylus a large clear thin apical lobe, without setae ventrally, few setae dorsally. Parapenial lobe and basal process of gonostylus absent. Dorsal gonostylus a simple ridge. (48) Penis valve (Fig. 334) without ventral keel, without dorsal crest; lateral edge raised. *Dorsal bridge inserted on penis valves near apices.* (49) *Volsella* (Fig. 333) *greatly enlarged,* with transverse ridge opposite notch and longitudinal ridge above notch, inner apical angle produced ventrally.

Species of *Halictillus* are small (about 5-6 mm) dull metallic bluish-green weakly punctured bees extremely similar in general appearance to species of the widespread non-augochlorine subgenus *Dialictus* (of *Lasioglossum*), with which they are sympatric. The females of *Halictillus* can be separated from *Dialictus* principally by the strong outer veins of the forewing of *Halictillus;* the eyes are also more deeply emarginate. Males of *Halictillus* have long *Corynura*-like antennae and lack the pygidial plate of males of *Dialictus.* The mouthparts and male hidden sternal and genitalic structure of *Halictillus* indicate a close relationship with *Corynura.* Most species of *Corynura* are much larger and quite different in general appearance; those few *Corynura* with which *Halictillus* could possibly be confused can be distinguished by the pectinate tibial spur, basally roughened propodeum, and more strongly angulate epistomal sulcus of *Halictillus.* The metasoma of the male is not petiolate. *Rhectomia* is another genus of small dull metallic *Dialictus*-like augochlorine bees with which *Halictillus* could possibly be confused; see the discussion of that genus. *Halictillus* has seldom been separated from *Dialictus* in collections, so its geographic range is not easily ascertainable. I have seen specimens from southern Brazil and Argentina. About three species are known; there are probably less than ten species in all.

Genus **Rhinocorynura** Schrottky

Corynura (Corynuropsis) Cockerell, 1901, Proc. Acad. Natur. Sci. Philadelphia 53:220. (Type species: *Corynura (Corynuropsis) darwini* Cockerell, 1901, original designation.) Preoccupied. NEW SYNONYMY.

Rhinocorynura Schrottky, 1909, Rev. Mus. La Plata 16:147. (Type species: *Halictus (Corynura* vel *Corynuropsis) inflaticeps* Ducke, 1907, monobasic and original designation.)

Ctenocorynura Schrottky, 1914, Deut. Entomol. Z. 1914:628. (Type species: *Ctenocorynura vernoniae* Schrottky, 1914, monobasic and original designation.)

Corynuroides Sandhouse, 1943, Proc. U. S. Nat. Mus. 92:540. New name for *Corynuropsis* Cockerell. NEW SYNONYMY.

Female

HEAD (Figs. 114-116). (1) Epistomal sulcus forming obtuse angle. (2) *Clypeus usually flat, apical portion abruptly beveled, posterior marginal area scarcely indented, median or lateral spines or tubercles usually present.* (4) Preoccipital ridge usually rounded, carinate in *R. briseis. Vertex swollen above ocelli.* (5, 6) Hypostomal floor about as long as wide, l/w = 1.06,

c/l = .20 (1 sp.). (7) Posterior flange of hypostoma projects beyond occiput. (8) Inner orbit of compound eye weakly to moderately emarginate, w/l = .099 to .129 (4 spp.). (11) *Labrum* (Figs. 143-144) *with distal process expanded, narrowed apically, fimbria on surface of process, keel low. Basal area short, basal elevation strongly notched or bituberculate.* (12) Mandible normal in small species, broad with subapical tooth produced (Fig. 165) in large species. (13) Distal portion of maxilla with base of galea distal to base of stipes, intermediate in position between that of *Augochlora* and *Corynura. Well-formed galeal comb present,* as in *Corynura* (Fig. 178). Inner strip with broad scale-like cuticular markings, long setae only at apex. (14) Maxillary palpus p/M = .29 to .41 (4 spp.). (15) Prementum with anterior conjunctival thickenings distal to its base, as in *Corynura* (Fig. 169) but prementum longer and more slender; pl/W = .55 to .59, pw/pl = .20 to .23 (4 spp.). (16) Salivary plate normal, broad V-shaped brace. (17) Glossa short, as in *Corynura,* gl/pl = .26 to .36, gl/W = .14 to .20 (4 spp.).

MESOSOMA. (19) *Pronotal dorsal ridge* (Fig. 186) *lamellate, forming flange from lateral angle to lobe.* Lateral angle may be produced beyond dorsal ridge, rounded or sharply angled. Lateral ridge sharply angled or rounded. (20) *Mesoscutum strongly produced over pronotum, lip high and sharp, usually slightly upturned and carinate.* (22) *Basal area of propodeum smooth, usually shiny, depressed transversely.* (24, 25) Marginal cell of forewing acute, cell long, mc/wl = .61 to .75 (4 spp.). (26) Small tibial spine present. (27) Hind tibial spur pectinate, teeth usually broad and rounded (Fig. 210). (29) Basitibial plate well-defined on all edges, narrowly rounded. (30) Anterior basitarsal brush weakly defined.

Male

HEAD. (35) Antenna not very long, reaching to scutellum or to just beyond propodeum, no plate areas; scape much longer than flagellomere, 2, sc/2 = 2.44 to 7.41, 2/1 = .94 to 1.15, 3/1 = 1.21 to 1.54, 10/1 = 1.18 to 1.72 (4 spp.). (36) Labrum with short triangular distal process, shorter than transverse basal area, basal elevation extending across basal area (based on 1 sp.).

METASOMA. (38) Metasoma usually elongate, not petiolate, rather compact and oval in 1 species. (39) Tergum VII abruptly convex apically, posterior margin emarginate medially, no gradulus. (40) *Anal lip of proctiger fringed with row of thin dark microtrichia,* proctiger frequently with cuticular striations and appearing stiffly extended (Fig. 234). (42-44) Sterna IV-VI normal, gradulus notched medially, posterior margin of VI weakly notched. (45) Sternum VII broadly produced posteriorly, truncate or emarginate, lined with setae. Apodemes slightly recurved. Posterior margin of sternum VIII not produced, or produced into median rounded lobe, without setae. Sternum VIII joins VII laterally at apices of apodemes. Spiculum narrow (Figs. 277-281).

(46) Gonobase (Figs. 337-344) with broad ventral bridge, rarely narrow, dorsal lobes weakly produced. (47) Ventral gonostylus variously produced apically (Figs. 337, 339, 341), lined with modified setae. Basal process of gonostylus present, bearing setae, small parapenial lobe present or absent. Dorsal gonostylus a narrow membranous swelling projecting from inner edge of lateral ridge, dorsally with small flap bearing long setae (Fig. 342) or with single long seta (Fig. 338). (48) Penis valve (Figs. 340, 343) with ventral keel, rounded dorsal crest bordering lateral longitudinal groove or depression, expanded laterally and medially. (49) Volsella (Fig. 344) more or less indented medially, apical inner angle more or less produced ventrally; base truncate or rounded.

The genus *Rhinocorynura* brings together a small but diverse group of species whose females are characterized by an enlarged head, broader than the thorax, with the vertex and genae produced, and an armed clypeus; both sexes have the mesoscutum and pronotum produced as described and the basal area of the propodeum smooth and usually shiny. Most species are rather variable in size, with the females highly variable in head size and clypeal armature. There appear to be three species groups, linked by intermediate species.

Species previously placed in *Corynuroides* are medium-sized, dark, metallic bees with the clypeal armature limited to coarse punctures or a median tubercle (Fig. 114), and the mandibles of the female are normal. The type species of *Corynuroides, Rhinocorynura briseis* (Smith), new combination (=*Corynura (Corynuropsis) darwini* Cockerell, according to Moure, 1944b), is largely dark with the mesoscutum and metasomal terga I and II coarsely punctate, and has a carinate preoccipital ridge; the genitalia are illustrated in Figs. 341-344. *Rhinocorynura crotonis* (Ducke), new combination, is dark metallic green and not coarsely punctate, and the preoccipital ridge is rounded. The genitalia more closely resemble those of the third species group mentioned below. *Corynuroides* might be deserving of subgeneric status if it were not for *crotonis* and the intermediate species discussed in the third group.

Rhinocorynura inflaticeps (Ducke), type species of the genus, is very variable in head size and clypeal armature of the female. Smaller specimens bear only a small central spine, and fit the description of the genus given by Schrottky (1909). Larger macrocephalic females (Fig. 115) have huge clypeal spines and fit the description by Schrottky (1914) of *Ctenocorynura,* as pointed out by Sakagami and Moure (1965). The male genitalia (Figs. 339-340) are somewhat different from those of species previously placed in *Corynuroides.* The bee is mostly dark, with dark anterior margins of the forewings.

The third group in *Rhinocorynura* has been recognized by a manuscript generic name by Moure; one of the species in it is rather large (about 9 mm), green, with a non-carinate mesoscutal lip and with the clypeus armed as shown in Fig. 116. The species rather resembles *R. inflaticeps* in the male genitalia (Figs. 337-338), hidden sterna (Fig. 281), and mandibles of the female (Fig. 165). However, a second small species belonging to this group on the basis of genitalic and mesoscutal characters is otherwise very similar to *R. crotonis* of the *Corynuroides* group; it is of the same size and coloring with unmodified female mandibles and a nearly unadorned clypeus.

Specimens of *Rhinocorynura* have been seen from Brazil, Bolivia, and Peru.

Cockerell (1901) first described a genus, *Corynuropsis,* to include species in this group, but, as pointed out by Sandhouse (1943), the name was preoccupied. The replacement name *Corynuroides* that Sandhouse (1943) proposed is subsequent to other names for this group and thus is a junior subjective synonym. Moure (1944b) discussed the validity and relationship of *Corynuroides,* considering it separate but closely related to *Rhinocorynura.* He did not know the male of *Rhinocorynura.*

Schrottky (1909a) proposed *Rhinocorynura* for a species previously placed conditionally in *Corynuropsis* Cockerell by Ducke (1907), based on the median spine of the clypeus of the female. Later, Schrottky (1914) proposed *Ctenocorynura* for a macrocephalic large-spined female which Moure (Sakagami and Moure, 1965) showed to be in the species *Rhinocorynura inflaticeps.* Sakagami and Moure (1965) discussed the head allometry of *R. inflaticeps* and synonymized *Ctenocorynura* with *Rhinocorynura.*

Genus **Corynurella,** new genus

(Type species: *Corynurella mourei,* new species.)

Female

HEAD (Fig. 117). (1) *Epistomal sulcus forming slightly acute angle.* (4) Vertex slightly swollen above ocelli. Preoccipital ridge rounded. (5, 6) Hypostomal floor over 1.5 times longer than wide, l/w = 1.83, c/l = .17 (1 sp.). (7) Posterior flange projects beyond occiput. (8) Inner orbit of compound eye rather weakly emarginate, w/l = .090 to .095 (2 spp.). (11) Labrum with distal process medially narrowly triangular, but projecting laterally from beneath posterior margin of basal area as rounded lobes, thus resembling *Rhinocorynura briseis* (Fig. 143); *basal elevation orbicular, strongly protuberant with apical surface flattened, similar to that of Pseudaugochloropsis* (Fig. 7). (13) Distal portion of maxilla with base of galea distal to base of stipes, as in *Rhinocorynura. Well-developed galeal comb present.* Inner strip with broad scale-like cuticular markings, long setae only at apex. (14) Maxillary palpus p/m = .44 to .45 (2 spp.). (15) Prementum with anterior con-

junctival thickenings distal to its base, as in *Rhinocorynura,* but longer and more slender, pl/W = .76 to .87, pw/pl = .17 to .19 (2 spp.). (16) Salivary plate normal, V-shaped brace. (17) Glossa moderately long, much longer than in *Rhinocorynura,* about half length of prementum, gl/pl = .57, gl/W = .50 (1 sp.)*.

MESOSOMA. (19) *Pronotal lateral angle strongly carinate both anteriorly and laterally, angle produced as shown in Fig. 184**. Dorsal ridge sharply angled but not carinate behind lateral angle, *lateral ridge carinate.* (20) Mesoscutum slightly produced over pronotum, low and sharply angled. (22) *Basal area of propodeum longer than scutellum, shiny with fine, close, principally transverse striae**. (24, 25) *Marginal cell of forewing acute, extending almost to tip of wing,* mc/wl = .79 (1 sp.). *Stigma very large.* (27) Hind tibial spur pectinate, teeth rounded. (29) Basitibial plate defined on all edges, narrowly rounded. (30) Anterior basitarsal brush apparently absent.

Male

HEAD. (35) Antenna moderately long, reaching scutellum, no plate areas, sc/2 = 4.00, 2/1 = .96, 3/1 = 1.49, 10/1 = 1.77 (1 sp.). (36) Basal elevation of labrum extending across basal area, not notched; distal process not examined.

METASOMA. (38) Metasoma elongate but not petiolate. (39) Tergum VII abruptly convex apically, posterior margin not emarginate, no gradulus. (40) Anal lip of proctiger fringed with row of thin dark microtrichae, proctiger with cuticular striations and appearing stiffly extended, as in *Rhinocorynura* (Fig. 234). (42-44) Sterna IV to VI normal, gradulus bowed posteriorly and interrupted medially on sternum VI, posterior margin of VI weakly notched. (Sterna IV and V not dissected). (45) Sternum VII produced posteriorly, emarginate and lined with setae, apodemes slightly recurved. Posterior margin of sternum VIII not produced; sternum VIII joins VII laterally at apices of apodemes. Spiculum narrow (Fig. 282).

(46) Gonobase (Figs. 335-336) with broad ventral bridge, dorsal lobes rather strongly produced. (47) Ventral gonostylus an elongate, apically and medially projecting lobe, bearing a few setae at its apex. Basal process of gonostylus small, with setae, parapenial lobe absent. Dorsal gonostylus a long flap projecting from lateral ridge, bearing long setae at its apex. (48) Penis valve without ventral prong, dorsal surface with a wide, rounded, longitudinal ridge, abruptly bordered laterally by a longitudinal groove; valve expanded medially and laterally. (49) Volsella indented medially, apical inner angle produced; base truncate.

*Exceptions

I have placed a small unique female from Paraguay tentatively in this genus. It is greener with less abundant testaceous areas than the type species,

and the basal area of the propodeum is about as long as the scutellum, shiny and depressed transversely as in *Rhinocorynura* with striae almost absent. The lateral angle of the pronotum is produced similar to that of *Rhectomia* (Fig. 185). The glossa is shorter than that of *Corynurella mourei,* gl/pl = .38, gl/W = .29. The head is comparatively shorter and broader.

At present *Corynurella* contains with certainty only the new species *mourei,* described in Appendix 1. It is a medium-sized (about 7 mm), rather shiny, weakly punctate species, largely testaceous with the head and dorsum of the mesosoma with dark bluish-green tints and the tip of the metasoma dark. *Corynurella* is closely related to *Rhinocorynura;* this relationship is especially evident in the male hidden sterna and terga and the genitalia. The species can be easily separated from species of *Rhinocorynura* by the normal, rather shiny, and weakly punctured clypeus of the female and the different pronotal, mesoscutal, and propodeal structures. The exceptional species noted above indicates an even closer similarity of *Corynurella* with *Rhectomia.* Until the males of this species and of *Rhectomia* are known, the extent of this similarity cannot be determined. If the males are quite similar, *Corynurella* should perhaps be considered a subgenus of *Rhectomia. Corynurella mourei* is noteworthy for the enlarged stigma and long marginal cell, obvious at a glance. Specimens of *Corynurella* have been seen from southern Brazil and Peru.

Derivation of *Corynurella:* Diminutive of *Corynura* (feminine).

Genus **Rhectomia** Moure

Rhectomia Moure, 1947, Publ. avulsas Mus. paranaense no. 3:9. (Type species: *Rhectomia pumilla* Moure, 1947, monobasic and original designation.)

Female

HEAD (Fig. 118). (1) Epistomal sulcus forming obtuse angle. (4) Vertex swollen above ocelli. Preoccipital ridge rounded. (5, 6) Hypostomal floor longer than wide. (8) Inner orbit of compound eye rather weakly emarginate, w/l = .109 (1 sp.). (11) *Labrum with distal process broadly triangular, as wide as basal area; basal elevation bituberculate.* (13) Distal portion of maxilla with base of galea distal to base of stipes, as in *Rhinocorynura. Well-developed galeal comb present.* Inner strip with broad scale-like cuticular markings, long setae only at apex. (14) Maxillary palpus p/M = .42 (1 sp.). (15) Prementum with anterior conjunctival thickenings distal to its base, as in *Rhinocorynura,* pl/W = .72, pw/pl = .19. (16) Salivary plate normal, V-shaped brace. (17) Glossa rather short, gl/pl = .27, gl/W = .20 (1 sp.).

MESOSOMA. (19) *Pronotal lateral angle strongly produced as in Fig. 185, carinate anteriorly and laterally, ending laterally above dorsal ridge.* Dorsal ridge sharply angled but not carinate. *Lateral ridge carinate.* (20) Mesoscutal

lip low but produced over pronotum, abruptly rounded, not narrowed. (22) *Basal area of propodeum long, smooth, without striae.* (24, 25) Marginal cell of forewing acute, not greatly lengthened, mc/wl = .60 (1 sp.); stigma not enlarged. (26) Weakly defined hind tibial spine present. (27) Hind tibial spur pectinate, teeth rounded. (29) Basitibial plate defined on all edges, narrowly rounded. (34) Anterior basitarsal brush apparently absent.

Rhectomia is known only from the type species, *R. pumilla* Moure, a small (about 5 mm) dull metallic green bee closely resembling in general appearance species of *Dialictus* but lacking the weakened outer wing veins in the female. The pronotal structure (Fig. 185) separates *Rhectomia* from other genera except the quite similar *Corynurella*. The differences in the marginal cell, stigma, and labrum aid in separating these two genera; they appear to be closely related (see discussion under *Corynurella*), but further decisions concerning their status cannot be made until the male of *Rhectomia* is known. *Rhectomia* is known only from southern Brazil.

Moure (1947) described in detail the type species and gave the characteristics of the genus.

Genus **Neocorynura** Schrottky

Female

HEAD (Fig. 119). (1) Epistomal sulcus forming obtuse angle. (4) *Preoccipital ridge carinate or lamellate.* (5, 6) Hypostomal floor less than 1.5 times as long as wide, l/w = .95 to 1.30 (4 spp.), c/l = .26 to .37 (5 spp.). (8) Inner orbit of compound eye deeply emarginate, w/l = .135 to .182 (8 spp.). (12) Mandible usually normal, occasionally with tip expanded, some species with subapical tooth produced so mandible appears bidentate at apex, rarely supplementary tooth present so mandible tridentate. (13) Distal portion of maxilla normal, inner strip with scale-like cuticular markings and setae only on outer border near apex. Small poorly formed galeal comb sometimes present, usually of 6 or less teeth. (14) Maxillary palpus, p/M = .35 to .52 (17 spp.). (15) Prementum normal, pl/W = .57 to .82, pw/pl = .17 to .25 (17 spp.). (16) Salivary plate normal, V-shaped brace. (17) Glossa usually 0.3 to 0.5 length of prementum, gl/pl = .34 to .59, gl/W = .22 to .48 (13 spp.).

MESOSOMA. (19) Pronotal lateral angle usually strongly produced (Fig. 187), sometimes weakly so or rounded; lateral ridge carinate or lamellate; dorsal ridge carinate. (20) *Mesoscutum usually narrowed anteriorly, mesoscutal lip usually narrow, high, projecting forward and sharply angled,* occasionally not narrowed, normal. (22) Basal area of propodeum usually striate, occasionally completely smooth or with weak basal striae. (23) *Propodeum usually narrowed posteriorly, lateral carinae little diverging,* rarely not narrowed. (24, 25) Marginal cell of forewing acute or very narrowly truncate

and appendiculate, mc/wl = .55 to .61 (7 spp.). (27) *Hind tibial spur pectinate* (Fig. 211). (29) Basitibial plate well defined on all edges, narrowly rounded. (30) Anterior basitarsal brush weakly defined.

METASOMA. (31-34) Sterna and terga usually normal, rarely pseudopygidial area of sternum V with scale-like setae bordering median slit.

Male

HEAD. (35) Antenna usually long, frequently surpassing propodeum, sc/2 = 1.43 to 2.40, 2/1 = 1.28 to 2.94, 3/1 = 1.60 to 2.94, 10/1 = 1.97 to 3.68 (11 spp.). (36) Labrum (Fig. 146) transverse, distal process very slightly developed, basal elevation extending across basal area.

METASOMA. (38) *Metasoma narrow, usually petiolate* (Fig. 222) *with first tergum decidedly narrower than the following,* occasionally first segment not decidedly narrowed. Sterna I and II long and narrow (Fig. 237). (39) Tergum VII abruptly convex apically, gradulus usually not or weakly defined, rarely well defined. (40) Anal lip of proctiger without post-anal filaments. (42-44) Sterna IV to VI normal, apex of VI weakly notched or entire. (45) Sternum VII usually not or slightly projecting posteriorly, rarely strongly projected into a median, rounded or truncate process, posterior margin or process with setae. Median posterior process of sternum VIII produced into long rounded process, usually surpassing posterior margin of sternum VII and without or with few setae, rarely with many setae; sternum VIII joining VII near apices of apodemes. Spiculum narrow (Figs. 283-285).

(46) Gonobase (Figs. 345-351) with narrow ventral bridge, dorsal lobes strongly projecting over gonocoxites. (47) Ventral gonostylus variable, see subgeneric descriptions. Dorsal gonostylus a simple ridge, usually flanged, occasionally with membranous process or inner border of flange or rarely with medially directed flap. (48) *Penis valve narrow, very long, surpassing gonostyli, without crest, inner edge higher, tip usually prolonged and curved* (Fig. 348). (49) Volsella large, more or less quadrate, inner apical margin usually more or less indented (Fig. 347).

Neocorynura is possibly the largest augochlorine genus, with species recorded from Mexico to Argentina. Typical species are medium-sized and largely black with some bright green reflections, although many species are bright green similar to typical *Augochlora*. The end of the mesosoma is narrowed in typical species and the metasoma narrowed basally and petiolate in the male, giving the bees a striking resemblance to polybiine wasps, heightened by darkly pigmented anterior margins of the forewings in some species. This general appearance is seldom duplicated by other augochlorine genera throughout *Neocorynura's* range except where it overlaps *Corynura* in the South Temperate Zone.

However, enough exceptions occur to make some species difficult to recognize as *Neocorynura* without examination of genitalia. At present I recognize

only one subgenus besides *Neocorynura s. s.;* other groups are too poorly represented and defined to merit separate status. Association of the sexes is particularly a problem.

Subgenus **Neocorynura** Schrottky

Cacosoma Smith, 1879, Descriptions of new species of Hymenoptera in the collection of the British Museum:39. Preoccupied. (Type species: *Cacosoma discolor* Smith, 1879, designated by Sandhouse, 1943.)

Neocorynura Schrottky, 1910, Deut. Entomol Z. 1910:540. New name for *Cacosoma* Smith, preoccupied.

Female

(11) Labrum (Fig. 145) with distal process narrow, usually shorter than or subequal to basal area, distal keel with edge rounded or slightly flattened. Basal elevation longitudinal, raised above basal area, gradually rounded or sharply angled. (4) Preoccipital ridge carinate, not exceptionally flanged. (19) Lateral ridge of pronotum carinate, not strongly lamellate. (31) Pseudopygidial area of metasomal sternum V with normal setae or scale-like setae.

Male

(35) Antenna usually long, plate areas frequently present. (47) Ventral gonostylus of genitalia (Fig. 345) a medially directed long flap, bearing setae in various patterns on flattened ventral surface with anterior ("lower") edge frequently prolonged and usually thin. Basal process of gonostylus present as small lobe without setae. Dorsal gonostylus (Fig. 346) without inner extension or with small membranous lobe. (48) Penis valve (Fig. 348) without ventral prong and with apex variously prolonged, curved, or otherwise modified.

At present *Neocorynura s. s.* contains all species of *Neocorynura s. l.* but one. Typical species have a narrowed propodeum, petiolate metasoma in the male, rounded basal elevation on the female clypeus, normal female mandible, and normal pseudopygidial area on tergum V.

A number of species from the Andes do not have tergum I of the male metasoma abruptly narrower than II, and do not have a strongly narrowed mesoscutum anteriorly nor produced pronotal lateral angles. Most species of this group have a granular propodeum with weak striae and do not obviously resemble *Neocorynura,* although most other characters are similar. The scutellum of one male is strongly bituberculate, similar to that of *Chlerogas.*

A second group of five females is characterized by strongly bidentate or tridentate mandibles and scales lining the pseudopygidial area. The basal elevation of the clypeus is strongly angled at the division of the upper and lower surfaces. Most, but not all, specimens do not have the propodeum narrowed. The one male associated with a female (*Neocorynura rufa* Michener) of this group has the posterior process of metasomal sternum VIII

greatly elongate, much surpassing the straight margin of sternum VII, with setae at its apex, and the inner edge of the penis valve produced and strongly elevated. A second male, not associated with any female, shares these characteristics. If this correlation of characters holds true when the sexes of more species are associated, the group deserves subgeneric status. In general appearance, bees of this group resemble typical *Neocorynura*.

Smith's original *Cacosoma* included species of both *Corynura* and the present *Neocorynura*. Schrottky (1910), in proposing *Neocorynura* to replace *Cacosoma*, stated that it was in no way synonymous with *Corynura*. However, he did not adequately separate the two genera, and most workers prior to 1940 (e.g., Herbst, 1917) except Schrottky and Cockerell (1919b) placed species now placed in *Neocorynura* in *Corynura* or *Rhopalictus*. Alfken (1926) correctly separated *Corynura* from species now placed in *Neocorynura*, except for *Corynura chilensis* (Spinola), thus he used the name *Rhopalictus* for *Neocorynura*.

Well known species of *Neocorynura s. s.* include *N. pubescens* (Friese) from Central America, and *N. pilosa* (Smith) and *N. jucunda* (Smith) from South America.

Subgenus **Neocorynuroides**, new subgenus
(Type Species: *Halictus rhytis* Vachal, 1904a.)

Female

(11) Labrum with distal process longer than basal area, distal keel flat-topped at apex. Basal elevation transverse, very low. (12) Mandible with apex slightly expanded and subapical tooth rather large, but apex not bidentate. (4) Preoccipital ridge strongly lamellate, flange recurving over genae. (19) Lateral ridge of pronotum strongly lamellate. (31) Pseudopygidial area of metasomal sternum V with scale-like setae bordering median slit.

Male

(35) Antenna not as long as in *Neocorynura s. s.*, reaching propodeum, no plate areas. (47) Ventral gonostylus of genitalia with seta-bearing surface facing inward (Figs. 349-350). No basal process. Dorsal gonostylus a thin clear flap (Fig. 351). (48) Penis valve with ventral prong, tip of valve not prolonged or modified.

Neocorynuroides contains only one known species, *Neocorynura rhytis* (Vachal). It is a distinctive small species, about 5.5 mm long, with the female mesoscutum black with purple tints and cut by transverse striae radiating from the median line, these striae occasionally light or absent. The male mesoscutum is green and lacks the striae. *N. rhytis* has a relatively short and wide proboscidial fossa, hypostomal l/w = .95 and c/l = .264; the mouthparts are correspondingly short and wide, pl/W = .57 to .58 and pw/pl =

.24 to .25 for 2 specimens. The maxillary palpus is not long, all segments being short and conical. The mesoscutum is strongly narrowed and its lip is elevated and produced forward at a sharp angle; the lateral angles of the pronotum are also strongly produced. The propodeum is narrowed posteriorly and its basal area bears strong striae. The male metasoma is petiolate.

The naming of a new subgenus is justified largely on the basis of the distinctive male genitalia, the gonostyli in particular being quite different from those of any *Neocorynura s. s.* I have seen specimens of *N. rhytis* (Vachal) from Bolivia and Peru.

Derivation of *Neocorynuroides:* Like *Neocorynura* (masculine).

Genus **Paroxystoglossa** Moure

Paroxystoglossa Moure, 1941, Arq. Zool. Estado São Paulo 2:59. (Type species: *Oxystoglossa jocasta* Schrottky, 1911, original designation.)

Female

HEAD (Fig. 120). (1) Epistomal sulcus forming obtuse angle. (4) Preoccipital ridge sharply angled*. (5, 6) Hypostomal floor about as long as wide, l/w = .96 to 1.20, c/l = .05 to .24 (3 spp.). (8) Inner orbit of compound eye moderately emarginate, w/l = .083 to .115 (3 spp.). (11) Labrum (Fig. 147) with distal process triangular, narrower than basal area; basal elevation suborbicular, protuberant, with distal surface somewhat flattened and indented or notched medially. (13) Distal portion of maxilla normal, inner strip with rather narrow scale-like cuticular markings, long setae only at apex. (14) Maxillary palpus, p/M = .27 to .40 (4 spp.). (15) Prementum normal, pl/W = .61 to .81, pw/pl = .16 to .21 (4 spp.). (16) Salivary plate normal. (17) Glossa of moderate length, less than half length of prementum, gl/pl = .35 to .45, gl/W = .22 to .36 (4 spp.).

MESOSOMA. (19) Pronotal lateral angle rounded, either produced (Fig. 188) or not. Lateral ridge sharply angled or rounded, dorsal ridge carinate. (20) *Mesoscutum narrowed anteriorly, lip high, projecting forward and sharply angled;* when lateral angle not produced, mesoscutum not narrowed and lip rounded, not high. (22) Basal area of propodeum with weak plicae or roughening basally, smooth apically. (23) *Propodeum not narrowed posteriorly.* (24, 25) Marginal cell of forewing narrowly truncate and appendiculate, or acute, mc/wl = .58 to .66 (3 spp.). (27) *Hind tibial spur serrate,* as in *Corynura chilensis* (Fig. 206). (29) Basitibial plate well defined on all edges, narrowly rounded. (30) Anterior basitarsal brush poorly defined or absent.

Male

HEAD. (35) *Antenna long, reaching to or beyond propodeum, scape short; flagellomere 2 about twice length of 1, longer than or subequal to length of 10,** sc/2 = 1.29 to 2.17, 2/1 = 1.99 to 2.13, 3/1 = 2.10 to 2.24, 10/1 = 1.78

to 2.17 (3 spp.). *No plate areas.* (36) Labrum transverse, distal process little developed, basal elevation extending across basal area, as in *Neocorynura* (Fig. 146).

METASOMA. (38) Metasoma rather broad to narrow and elongate, but not petiolate, segments I and II not decidedly long and narrow. (39) Tergum VII gradually convex apically, gradulus absent or weakly defined. (40) Anal lip of proctiger without post-anal filaments. (42) *Sternum IV* (Fig. 238) *with shiny, median apical depression bordered by sharply raised ridges, or posterior margin emarginate, central postgradular area depressed and shiny.* (43) *Sternum V* (Fig. 239) *with median shiny depression usually bordered by strong ridges or elevations and modified setae.* (44) Sternum VI (Fig. 240) deeply notched, strongly depressed apically. (45) Sternum VII produced posteriorly into rounded or subtruncate seta-bearing median process, frequently with median ridge; apodemes recurved slightly anteriorly. Sternum VIII produced posteriorly into small median lobe, bearing few long setae or without setae; laterally joining VII near apices of apodemes. Spiculum rather narrow (Fig. 286-288). (46) Gonobase (Figs. 352-355) with narrow ventral bridge, dorsal lobes strongly projecting over gonocoxites. (47) Ventral gonostylus an elongate lobe bearing long setae on its dorsal and outer portion of ventral surfaces. Basal process of gonostylus and parapenial lobe absent. Dorsal gonostylus a medially directed thin narrow flap. (48) Penis valve (Fig. 355) with ventral prong and rounded dorsal crest posterior to dorsal depression; valve somewhat expanded laterally and medially, with small projection on lateral margin near apex of crest. (49) Volsella (Fig. 354) with inner edge emarginate, inner apical angle somewhat prolonged, base truncate.

*EXCEPTIONS

The preoccipital ridge of many, but not all, males is carinate. The antennae of the males of two species are much shorter than described above, with the scape longer and flagellomere 2 not much longer than 1; $sc/2 = 3.80$, $2/1 = 1.00$, $3/1 = 1.11$, $10/1 = 1.52$ (1 sp.).

Paroxystoglossa is a diverse genus of about 9 species of medium sized, variously colored bees. The females of most species are largely dark-colored with a narrowed mesoscutum and produced pronotal lateral angles and strongly resemble many *Neocorynura*. The tibial spur is the best characterisitc to separate female *Paroxystoglossa* from *Neocorynura;* the non-carinate preoccipital ridge and unnarrowed propodeum are also aids. A few species of *Paroxystoglossa* are usually bright green in the female, without a decidedly narrowed mesoscutum or produced lateral angles. They are rather nondescript green bees best recognized by their tibial spurs.

Males are usually green, rarely dark, and typically have long antennae and an elongate metasoma. Metasomal sterna IV and V are characteristically

modified and serve to separate externally these bees from species of *Neocorynura;* these modifications range from strong ridges on both sterna to more gradual shiny depressions with the fourth sternum emarginate. The genitalia of *Paroxystoglossa* are quite different from those of *Neocorynura.* The femora of some males are swollen and the males ventrally on the head, mesosoma, and legs usually bear long plumose hairs. The bright green males of two species are quite different in general appearance, being compact with short antennae and non-carinate preoccipital ridges; the metasomal sterna of these species are strongly modified. Species of *Paroxystoglossa* are known from southern Brazil to Argentina.

Moure (1941a) described *Paroxystoglossa* for two Brazilian species Schrottky had placed in *Oxystoglossa.* Moure (1960a) has recently published a specific revision to *Paroxystoglossa,* including a key to the 9 species that he has recognized.

Genus **Andinaugochlora,** new genus

(Type species: *Andinaugochlora micheneri,* new species.)

Female

HEAD (Fig. 121). (1) *Epistomal sulcus forming right or slightly acute angle.* (4) Preoccipital ridge sharply angled or carinate. (5, 6) Hypostomal floor longer than wide, l/w = 1.49, c/l = .43 (1 sp.). (7) Posterior flange projects beyond occiput. (8) Inner orbit of compound eye deeply emarginate, w/l = .169 to .176 (2 spp.). (11) Labrum (Fig. 148) with distal process narrow and triangular, shorter than basal area. Basal elevation ovate, rounded, strongly protuberant. (13) Distal portion of maxilla with or without small galeal comb, as in *Neocorynura;* inner strip with narrow scale-like cuticular markings, long setae only at apex. (14) Maxillary palpus, p/M = .28 to .33 (2 spp.). (15) Prementum normal, pl/W = .70 to .73, pw/pl = .16 to .18 (2 spp.). (16) Salivary plate normal, V-shaped brace. (17) Glossa moderately long, gl/pl = .41 to .52, gl/W = .30 to .36 (2 spp.).

MESOSOMA. (19) *Pronotal lateral angle not produced, forming obtuse angle.* Dorsal ridge weakly carinate; lateral ridge abruptly rounded. (20) Mesoscutum not narrowed anteriorly, lip rounded. (22) Basal area of propodeum granular, weakly plicate basally. (23) Posterior surface not exceptionally narrowed, unlike *Neocorynura.* (24, 25) Marginal cell of forewing narrowly truncate and appendiculate, mc/wl = .59 (1 sp.). (27) *Hind tibial spur pectinate* (Fig. 212). (29) *Basitibial plate well defined posteriorly, obsolescent anteriorly, sharply rounded* (Fig. 203). (30) Anterior basitarsal brush well defined.

Male

HEAD. (35) *Antenna very long, reaching beyond propodeum, scape short, flagellomere 2 over 1.5 times length 1, plate area present,* sc/2 = 1.63 to 2.03,

2/1 = 1.59 to 2.16, 3/1 = 1.89 to 2.16, 10/1 = 2.45 to 2.94 (3 spp.). (36) Labrum transverse, distal process little developed, basal elevation extending across basal area, weakly notched or entire, as in *Neocorynura* (Fig. 146).

METASOMA. (38) Metasoma elongate but not petiolate, segments I and II not very long and narrow. (39) Tergum VII more or less abruptly convex apically, gradulus weakly defined or absent. (40) Anal lip of proctiger without post-anal filaments. (42, 43) Sterna IV and V not modified, postgradular area of V centrally somewhat depressed, with short setae, laterally with longer setae. (44) *Apex of sternum VI* (Fig. 241) *strongly notched, with deep concavities to either side of notch and apical margin curved ventrally,* median ridge between concavities with modified setae. (45) Posterior margins of sterna VII and VIII produced medially, VII and occasionally VIII bearing setae. Apodemes of VII little recurved, sternum VIII joining VII at apices of apodemes. Spiculum broad (Figs. 290-292).

(46) Gonobase (Figs. 358-361) with narrow ventral bridge, dorsal lobes strongly projecting over gonocoxites. (47) Ventral gonostylus a medially directed lobe bearing modified setae on outer (ventral) edge, prolonged caudally above gonocoxite*. Basal process of gonostylus and parapenial lobe absent. Dorsal gonostylus a narrow, thin, medially projecting flap, arising from inner edge of dorsal ridge*. (48) Penis valve (Fig. 360) with ventral prong and dorsal crest distal to dorsal depression; valve with high flange on medial edge of dorsal depression. (49) Volsella (Fig. 361) more or less rounded basally, with deep depression above notch*.

*EXCEPTIONS

In one species, the caudal prolongation of the ventral gonostylus of the male genitalia forms a prolonged thin flange, and the dorsal gonostylus is a broader flap, expanded and spiculate apically. In this species, the volsella is notched apically and ridged, but does not bear a deep depression.

Andinaugochlora is known from four species from the high Andes. (All specimens thus far have been collected at altitudes of over 2500 meters.) The bees are largely green, sometimes with cupreous, yellow, or blue tints. The known females have striate pleurae. In general the bees are long-haired and largely granular and closely resemble the high Andean complex of *Neocorynura* mentioned in the discussion of that genus. The females of *Andinaugochlora* can be distinguished from *Neocorynura* by the epistomal sulcus and basitibial plate. The males are most easily recognized externally by the sixth metasomal sternum; the genitalia are quite different from those of *Neocorynura.*

The type species is described as new in Appendix 1. The alpine South American halictines are very poorly represented in collections, so an accurate estimate of the number of species and range of morphological variation in

Andinaugochlora must await further field work. Specimens of *Andinaugochlora* have been seen from Colombia, Ecuador and Peru.

Derivation of *Andinaugochlora:* Andean, plus *Augochlora* (feminine).

Genus **Chlerogas** Vachal

Chlerogas Vachal, 1904, Misc. Entomol. (Narbonne) 12:127. (Type species: *Halictus chlerogas* Vachal, 1904a, monobasic.)

Male

HEAD (Figs. 136-137). (1) *Epistomal sulcus forming right angle.* (3) *Malar area greatly elongate, twice as long or longer than distance between mandibular articulations, head very elongate.* (4) Preoccipital ridge sharply angled, not carinate . (8) Inner orbit of compound eye moderately emarginate (in male). (35) Antenna long, reaching to propodeum or beyond, plate areas present, sc/2 = 2.37, 2/1 = 1.28, 3/1 = 1.61, 10/1 = 2.04 (1 sp.). (36) Labrum with basal elevation extending across basal area, weakly notched or entire; distal process not examined. (13-16) Mouthparts not dissected, not greatly narrowed or obviously modified, maxillary palpi rather long and slender.

MESOSOMA. (19) Pronotal lateral angle obtuse, not produced, rounded; lateral ridge rounded; dorsal ridge sharply angled but not carinate. (20) Mesoscutum not narrowed anteriorly, lip low and rounded. *Scutellum produced into two large tubercles.* (22) Basal area of propodeum with fine regular plicae or weak plicae basally, smooth posteriorly. (23) Posterior surface of propodeum strongly narrowed *(hirsutipennis)* or not *(C. ?chlerogas),* lateral carinae slightly diverging. (24, 25) Marginal cell of forewing acute, mc/wl = .62 (1 sp.). (37) *Inner hind tibial spur pectinate, with 3-5 long teeth.*

METASOMA. (38) Metasoma elongate, not petiolate. Tergum VI of *C. hirsutipennis* produced laterally into lamellae bordering shiny depressions, visible dorsally without dissection; not produced in *C. ?chlerogas.* (39) Tergum VII gradually convex, with distinct gradulus. (40) Anal lip of proctiger without post-anal filaments. (42) Sternum IV normal (not dissected). (43) Sternum V normal or emarginate, with long setae on postgradular area (not dissected). (44) Sternum VI (Fig. 242) deeply notched, medially depressed with longitudinal keel. (45) Sternum VII produced posteriorly into rounded lobe bearing short setae, apodemes little recurved. Sternum VIII similarly produced posteriorly, without setae; laterally joining VII at apices of apodemes. Spiculum moderately broad (Fig. 289).

(46) Gonobase (Figs. 356-357) very large, ventral bridge narrow, dorsal lobes moderately produced. Ventral bridge of gonocoxites expanded medially. (47) Ventral gonostylus an apically projecting lobe, with setae only on apical edge of flattened ventral surface, also on dorsal surface. Basal process of gonostylus and parapenial lobe absent. Dorsal gonostylus an expanded, clear,

thin lobe with cuticular wrinkles, projecting from seta-bearing rounded lateral ridge. Narrow thin projection extends apically from anterior margin of dorsal gonostylus, ventral or dorsal to rest of gonostylus. (48) Penis valve narrow, no ventral prong, rounded dorsal ridge posterior to small dorsal depression; narrow longitudinal depression lateral to dorsal ridge. (49) Volsella indented on inner margin, notch near apex, base truncate.

Chlerogas is known from two rather large (about 12 mm) weakly punctate species, one bright green and the other largely blackish. Through the courtesy of Dr. Richard Froeschner of the United States National Museum, I have been able to study the externally visible features of the holotype of *Chlerogas hirsutipennis* Cockerell. Dr. Henry Townes has graciously lent me a male specimen of *Chlerogas* which he collected at Machu Picchu, Peru, which agrees with the description that Vachal (1904a) gave for *C. chlerogas* (Vachal), and he allowed me to dissect its genitalia. The extraordinary development of the head and the bituberculate scutellum readily distinguish these species from species of any other genera. A male specimen of *Neocorynura* also shares the character of the bituberculate scutellum. The female is unknown, as discussed below, and there is no reason to surmise that the species of *Chlerogas* are social parasites, as suggested by Vachal (1904a) and Cockerell (1919a). Specimens have been recorded only from Peru.

Vachal (1904a) described his specimen of *Halictus chlerogas* as female, due to its pectinate tibial spur and tarsal claw. The end of the abdomen and the antennal flagella had apparently been lost ("Le funicle et le bout d'abdomen manquant. . . ."). He thus proposed a new genus for the species if it were to be proven to be a social parasite, and said that the name of the species should become *Chlerogas latitans* Vachal, a change which is not permitted by the International Code, as noted by Cockerell (1919a). Moure (personal communication) has examined the holotype of *Chlerogas chlerogas* in the Paris Museum and found it to be a male.

Cockerell (1919a) in describing the second species of *Chlerogas,* agreed with Vachal's suggestion about the social parasitic appearance of the bees and the validity of the separate genus. He described the holotype of his new species, *Chlerogas hirsutipennis,* as a female. However, the only known specimen is definitely a male.

Genus **Augochloropsis** Cockerell

Female

HEAD (Fig. 122). (1) Epistomal sulcus forming obtuse angle. (4) Preoccipital ridge sharply angled or carinate. (5, 6) Hypostomal floor longer than wide, $l/w = 1.39$ to 1.76, $c/l = .56$ to .75 (7 spp.). (7) Posterior flange projects beyond occiput. (8) Inner orbit of compound eye moderately emargi-

nate, w/l = .101 to .157 (13 spp.)*. (11) *Labrum* (Fig. 151) *with distal process expanded, as wide as basal area, distal keel projecting beyond apex, with lateral extensions near basal area. Basal elevation strongly notched medially. Labral fimbria on anterior surface of distal process.* (13) Distal portion of maxilla normal, apical lobe well-defined on outer surface, inner strip with broad scale-like cuticular markings and long setae only at apex. (14) Maxillary palpus, p/M = .28 to .38 (21 spp.). (15) Prementum normal, pl/W = .54 to .70, pw/pl = .12 to .20 (23 spp.). (16) Salivary plate normal, V-shaped brace. (17) Glossa 1/3 to 1/2 length of prementum, gl/pl = .33 to .49, gl/W = .21 to .31 (21 spp.)*.

MESOSOMA. (19) *Pronotal dorsal ridge strongly lamellate, forming flange from lateral angle to lobe* (Fig. 189)*, lateral angle sometimes produced beyond flange. Lateral ridge rounded, rarely sharply angled. (20) Mesoscutum not narrowed anteriorly, lip usually broadly rounded. (21) *Tegula with inner posterior angle produced* (Fig. 199). (23) Posterior surface of propodeum wide ventrally, lateral carinae subparallel and arising considerably lateral to posterior submarginal pits. (24, 25) Marginal cell of forewing truncate, usually appendiculate, mc/wl = .44 to .55 (11 spp.). (27) *Hind tibial spur pectinate, all teeth long* (Fig. 213). (29) *Basitibial plate very short, extending barely past apex of femur, all edges defined* (Fig. 204). (30) Anterior basitarsal brush well defined.

METASOMA. (31, 32) Terga V and VI normal, pygidial plate may be notched apically. (34) Sternum IV with gradulus present basally, rarely obsolescent.

Male

HEAD. (35) Antenna not greatly elongate, sc/2 = 3.10 to 4.69, 2/1 = .81 to 1.30, 3/1 = .99 to 1.60, 10/1 = 1.12 to 1.75 (9 spp.). No plate areas. (36) *Labrum* (Fig. 152) *with distal process expanded as in female,* basal elevation notched medially and extending across basal area.

METASOMA. (39) Tergum VII (Fig. 226) gradually convex apically, gradulus present and nearing antecosta medially, a line extending from gradulus to spiracle*. (40) Anal lip of proctiger without or with short postanal filaments (Fig. 235). (42) *Sternum IV laterally produced into caudally directed processes, bearing setae, apical margin with median triangular lobe, gradulus meeting antecosta medially* (Figs. 243-244)*. (43) Sternum V unmodified or with hair tufts and marginal incisions (see subgeneric descriptions). (44) Sternum VI notched medially, truncate, post-gradular area laterally more or less elevated to form flanges surpassing dorso-lateral areas, setae densest medially (Figs. 246-247). (45) Sternum VII with truncate or rounded median posterior projection, bearing setae; apodemes slightly recurved anteriorly. Sternum VIII with posterior median projection variously developed,

usually bilobed, occasionally nearly absent, without setae or with few small setae; laterally joining sternum VII near apices of apodemes, spiculum broad (Figs. 293-297).

(46) Gonobase (Figs. 362-369) with narrow or membranous ventral bridge, dorsal lobes strongly projecting over gonocoxites. (47) Ventral gonostylus complex, apically a seta-bearing lobe; continued basally as a broad lobe bearing small setae on ventral surface and strong setae on apical edge, and with medial extension bearing a more or less well-defined long thin process. Basal process of gonostylus absent. Dorsal gonostylus a curved transparent lobe, usually bearing cuticular markings or dark patch of setae on inner surface. (48) Penis valve (Figs. 364, 369) with small ventral keel and pronounced darkly pigmented dorsal crest apical to dorsal depression; valve expanded medially and laterally. (49) Volsella (Fig. 368) with transverse ridge and depression below notch, apical median angle prolonged into ventrally (outwardly) directed projection.

*Exceptions

One species with an exceptionally broad head and produced genae has the eyes less emarginate, w/l = .083. Another species with an elongate head has the mouthparts also somewhat elongate, pl/W = .83 and gl/W = .38. A few species have the pronotal dorsal ridge less developed, strongly carinate but not forming a definite flange. One species lacks a gradulus on metasomal tergum VII of the male. Four males examined do not have distinct processes on sternum IV, although the apical margins are somewhat produced laterally (Fig. 245), and one species also lacks the median apical triangular lobe.

Augochloropsis is one of the largest of the augochlorine genera, represented from Canada to Argentina. Most of its members are medium sized to large, brilliant green or blue, frequently partly crimson or golden. The genus is easily recognized by a number of distinctive characters; the pronotum, tegulae, and labrum being the most easily observed without dissection. Metasomal sternum IV of the male is quite distinctive but the lateral processes are not usually visible without dissection, although when long they frequently protrude from beneath overlapping terga. In addition, many (but not all) species have a distinctive row of thick setae subapically on metasomal terga I to III (Fig. 224), called the "vibrissae," which led Vachal (1911) to name the group the *Halicti vibrissati*. As mentioned in the historical review, most of the species in *Augochloropsis* described prior to 1930 were placed in *Augochlora*.

Augochloropsis can be divided into two subgenera, well separated by male genitalic and sternal characters but poorly so in the female. These subgenera contain some small species groups which I do not at present consider worthy of subgeneric status.

Subgenus **Augochloropsis** Cockerell

Augochlora (Augochloropsis) Cockerell, 1897, Can. Entomol. 29:4. (Type species: *Augochlora subignita* Cockerell, 1897, original designation.)

Female

(22) Basal area of propodeum deeply and regularly pitted or strongly striate basally, smooth apically.

Male

(36) Distal process of labrum truncate or notched apically, with weak median groove on process. (39) Metasomal tergum VII with gradulus medially notched (Fig. 227). (42) Metasomal sternum IV with thick long setae anterior to lateral processes and on inner edges of processes, not on rounded apices (Fig. 243)*. (43) Sternum V with apical margin variously notched, postgradular area with long curved setae, frequently with median tuft of erect setae. (44) Sternum VI with wide apical postgradular flanges, variously modified (Fig. 246). (45) Sternum VII with narrow median posterior projection, sometimes ridged (Fig. 296)*. (47) *Ventral gonostylus apically bearing a row of strong, flattened, regular setae* (Figs. 362-363). (48) *Penis valve with very high crest* (Figs. 364-365).

*Exceptions

See exceptions of *Augochloropsis s. l.* In three species with the lateral projections of metasomal sternum IV not developed, rows of strong setae are present anterior to the apical margin in typical position. One species examined has the median posterior projection of sternum VII more broadly rounded than as shown in Fig. 296, and one other has the projection narrowly truncate, with few setae.

Cockerell (1897) first described *Augochloropsis* as a subgenus of *Augochlora* on the basis of the pectinate hind tibial spur, and later (1900) gave more differences between the two groups. Schrottky (1906) divided *Augochloropsis* into two subgenera, *Paraugochloropsis* (*Halicti vibrissati* of Vachal) with setal borders on the metasomal terga and *Pseudaugochloropsis (Halicti sericei)* without setal borders. In a later paper, Schrottky (1909b) reserved *Augochloropsis* for bees similar to *Augochlora,* but with a 3-toothed tibial spur, and named *Tetrachlora* as a subgenus of *Augochlora* for species with a 4-toothed spur, and retained *Augochlora (Paraugochloropsis)* for species with a 5-7-toothed spur and abdominal vibrissae. After learning of the identity of the type species of Cockerell's *Augochloropsis,* Schrottky (1910) proposed *Paraugochlora* for the group he previously considered as *Augochloropsis,* and referred *Augochloropsis* to the group he had called *Tetrachlora, Augochloropsis* being the senior synonym.

The first adequate description of *Augochloropsis* was given by Vachal (1911), who called the group the *Halicti vibrissati.* Prior to 1937, most bees

now placed in *Augochloropsis s. l.* were placed in *Augochlora.* Sandhouse (1937) described *Augochloropsis* in detail and synonymized *Paraugochlora* and *Tetrachlora* with it. Moure (1941a) also noted the characteristics of *Augochloropsis,* considering it a subgenus of *Augochlora.* He later (1943) noted that the designation of type species of *Augochlora* had changed the meaning of *Augochlora* to coincide with *Odontochlora* and not with *Augochloropsis,* and thus raised *Augochloropsis* to the generic level and created a tribe, the Augochloropsini, for it.

The division of *Augochloropsis* into subgenera based on the characters of this study has not previously been recognized. Other generic names now considered to be synonyms of *Augochloropsis s. l.* pertain to the second subgenus, discussed below.

The best known species of *Augochloropsis s. s.* is *A. ignita* (Smith) [senior synonym of *A. subignita* (Cockerell)].

Subgenus **Paraugochloropsis** Schrottky

Augochloropsis (Paraugochloropsis) Schrottky, 1906, Z. Syst. Hymenopter. Dipter. 6:312. (Type species: *Augochloropsis (Paraugochloropsis) lycorias* Schrottky, 1906, monobasic.)

Augochlora (Tetrachlora) Schrottky, 1909, Deut. Entomol. Z. 1909:481. (Type species: *Halictus multiplex* Vachal, 1903, monobasic.)

Paraugochlora Schrottky, 1910, Deut. Entomol. Z. 1910:540. (Type species: *Augochlora spinolae* Cockerell, 1900, original designation.)

Rivalisia Strand, 1921, Arch. Naturgeschichte abt. A, 87:270. (Type species: *Rivalisia metallica* Strand, 1921, monobasic.) NEW SYNONYMY.

Augochlora (Glyptobasis) Moure, 1941, Arq. Zool. Estado São Paulo 2:48. (Type species: *Augochlora (Glyptobasis) chloëra* Moure, 1941a, original designation.) Preoccupied.

Glyptobasia Moure, 1941, Arq. Mus. paranaense 1:98. New name for *Glyptobasis* Moure, preoccupied.

?*Augochloropsis (Glyptochlora)* Moure, 1958, J. New York Entomol. Soc. 66:188. (Type species: *Megalopta ornata* Smith, 1879, original designation.)

Female

(22) Basal area of propodeum smooth, irregularly roughened, or with light plicae, not as described for subgenus *Augochloropsis**.

Male

(36) Distal process of labrum rounded, without median groove (Fig. 152). (39) Metasomal tergum VII with gradulus not notched (Fig. 226). (42) Metasomal sternum IV with long thin lateral processes, clothed with setae to apices, patches of short stout setae anterior to processes (Fig. 244)*. (43) Sternum V with apex not notched, setae not modified, occasionally slightly denser medially. (44) Sternum VI with postgradular flanges little developed (Fig. 247). (45) Sternum VII with truncate or broadly rounded posterior median process (Figs. 293-295). (47) *Ventral gonostylus apically bearing dense unmodified setae* (Fig. 366). (48) *Penis valve with crest of medium height,* as in Fig. 369.

*Exceptions

In a few species, the basal area of the propodeum bears well-impressed striae as in *Augochloropsis s. s.* In one species examined, the lateral projections of metasomal sternum IV are short, and in the type species of *Glyptobasia,* they are essentially absent (Fig. 245).

Paraugochloropsis is much the larger in number of species of the two subgenera and the only one found north of Mexico. I have not been able to study holotypes of the type species of *Paraugochloropsis* or *Paraugochlora,* but their descriptions leave little doubt as to their subgeneric position and specimens in the University of Kansas collection which match their descriptions belong here. *Tetrachlora* appears to be a synonym of *Paraugochloropsis,* judging by specimens of *Augochloropsis euphrosyne* (Holmberg), which according to Schrottky (1909b) is a synonym of the type species of *Tetrachlora, A. multiplex* (Vachal). I have not seen specimens identified as *multiplex,* although the specific description fits specimens of *euphrosyne.*

Rivalisia was proposed for African bees. However, the holotype of the type species is definitely a member of *Paraugochloropsis* and undoubtedly South American in origin. Its systematic position is discussed in Appendix I, under *Augochloropsis metallica* (Strand).

Glyptobasia was described for two coarsely punctate species with unusual propodeal structure (see Moure, 1941a). In addition, both species have a low basal elevation of the female labrum which is only developed in the apical portion of the basal area, with the apical and lateral margins of the basal area high and merging with the elevation. The marginal area of the clypeus is produced between the clypeal teeth. Metasomal sternum IV of the male of *Glyptobasia chloëra* Moure lacks lateral processes (Fig. 245) and the posterior median processes of sterna VII and VIII are low (Fig. 297). However, other characters, especially the genitalia, resemble those of typical *Paraugochloropsis,* and most of the above characteristics are individually found in more typical species of *Augochloropsis,* so I prefer to consider the two species as representing a species group within *Paraugochloropsis.*

Glyptochlora must tentatively be considered a synonym of *Paraugochloropsis* on the subgeneric level, as the male is unknown. I have not seen the type species, but an unidentified female specimen available to me has been compared with the holotype of the type species in the British Museum (Natural History) by Dr. C. D. Michener and found to be congeneric. Moure (1958b) has described the type species in detail; the most noteworthy features are the extremely coarse punctation, the propodeal structure, the sharply ridged vertex behind the ocelli, and the produced and lamellate mesoscutal lip (Fig. 190). The marginal area of the clypeus is produced. As noted by Moure (1958b), the group resembles *Glyptobasia.*

Well known species of *Paraugochloropsis* include *Augochloropsis metallica* (Fabricius) from North America, and *A. vesta* (Smith) and *A. argentina* (Friese) from South America.

Genus **Augochlorodes** Moure

Augochlorodes Moure, 1958, J. Kansas Entomol. Soc., 31:53. (Type species: *Augochlorodes turrijaciens* Moure, 1958a, monobasic and original designation.)

Female

HEAD. (1) Epistomal sulcus forming obtuse angle, as in *Augochloropsis* (Fig. 122). (4) *Preoccipital ridge gradually rounded.* (5, 6) Hypostomal floor longer than wide, l/w = 1.21, c/l = .34 (1 sp.). (8) Inner orbit of compound eye moderately emarginate, as in *Augochloropsis,* w/l = .128 (1 sp.). (11) Labrum (Fig. 150) with short, narrow, triangular distal process; basal elevation suborbicular, rounded, strongly protuberant. (13) Distal portion of maxilla normal, inner strip with broad scale-like cuticular markings and long setae on surface. (14) Maxillary palpus p/M = .48 (1 sp.). (15) Prementum normal, pl/W = .60, pw/pl = .16 (1 sp.). (16) Salivary plate normal, V-shaped brace. (17) Glossa of moderate length, as in *Augochloropsis,* gl/pl = .45, gl/W = .27 (1 sp.).

MESOSOMA. (19) Pronotal lateral angle not produced, obtuse. Dorsal ridge strongly carinate; lateral ridge abruptly rounded. (20) Mesoscutum not narrowed anteriorly, lip rounded. (22) Basal area of propodeum with weak striae basally, smooth apically. (24, 25) *Marginal cell of forewing acute,* stigma enlarged, mc/wl = .60 (1 sp.). (27) *Hind tibial spur pectinate.* (29) Basitibial plate well defined on all edges, narrowly rounded. (30) Anterior basitarsal brush weakly defined.

Male

HEAD. (35) Antenna moderately long, reaching scutellum, no plate areas; sc/2 = 2.46, 2/1 = 1.18, 3/1 = 1.42, 10/1 = 1.57 (1 sp.). (36) Labrum transverse, distal process little developed, basal elevation extending across basal area, not notched.

MESOSOMA. (37) Inner hind tibial spur with long serrations.

METASOMA. (38) Metasoma elongate, not petiolate. (39) Tergum VII abruptly convex apically, posterior surface somewhat flattened, no gradulus. (40) Anal lip of proctiger with short stubby post-anal filaments. (42) *Sternum IV* (Fig. 248) *produced posteriorly at corners of postgradular area, bearing long flattened setae;* gradulus joining antecosta medially. (43) *Sternum V with dense clump of setae medially.* (44) Sternum VI normal, shallowly notched apically. (45) Sternum VII slightly produced posteriorly into truncate lobe, bearing short setae; anteriorly slightly pointed medially, apodemes slightly recurved. Sternum VIII not produced posteriorly, without setae; laterally joining VII at apices of apodemes. Spiculum broad (Fig. 298).

(46) Gonobase (Figs. 375-376) with narrow ventral bridge, dorsal lobes weakly defined. (47) Ventral gonostylus a broad lobe bearing modified setae on its ventral surface, continued anteriorly as thin medially-directed seta-bearing flap. Basal process of gonostylus absent. Dorsal gonostylus a large transparent thin lobe with cuticular wrinkles, continued apically and ventrally as a well-sclerotized hook-like projection and medially as a projection dorsal to the penis valve. (48) Penis valve with ventral prong and dorsal crest, expanded medially and laterally. (49) Volsella truncate basally, inner apical angle produced and projecting ventrally; transverse ridge below notch.

Augochlorodes contains one medium sized (about 7.5 mm) green species, *A. turrifaciens* Moure, nondescript except for the enlarged stigma of the forewing. The bee is weakly punctured with weak propodeal plicae defined only basally and rather resembles species of *Augochlorella* at first glance. The genitalic and sternal structure of the male suggest a relationship with *Augochloropsis*. The female can be distinguished from genera which it resembles by the rounded preoccipital ridge, non-lobed epistomal sulcus, and pectinate tibial spurs; the males are most easily distinguished externally by the fourth and fifth metasomal sterna. The genus is known only from southern Brazil.

Moure (1958a) gives additional characters to distinguish the genus and type species.

Genus **Thectochlora** Moure

Thectochlora Moure, 1941, Arq. Zool. Estado São Paulo 2:51. (Type species: *Halictus alaris* Vachal, 1904a, monobasic and original designation.)

Female

HEAD (Fig. 123). (1) Epistomal sulcus forming obtuse angle. (4) Preoccipital ridge rounded. (5, 6) Hypostomal floor longer than wide, l/w = 1.16, c/l = .24 (1 sp.). (8) Inner orbit of compound eye moderately emarginate, w/l = .135 (1 sp.). (11) Labrum (Fig. 149) with distal process triangular, narrower than basal area, labral teeth strong; basal elevation rounded and protuberant. (13) Distal portion of maxilla normal, inner strip with broad scale-like cuticular markings and long setae only at apex. (14) Maxillary palpus p/M = .35 (1 sp.). (15) Prementum pl/W = .62, pw/pl = .20 (1 sp.). (16) Salivary plate normal, V-shaped brace. (17) Glossa rather short, less than half length of prementum, gl/pl = .38, gl/W = .24 (1 sp.).

MESOSOMA. (19) *Pronotal dorsal ridge* (Fig. 191) *strongly lamellate, forming flange from lateral angle to lobe,* lateral angle produced and rounded. Lateral ridge rounded. (20) *Mesoscutum produced anteriorly to project over pronotum as lamellate lip.* (22) *Basal area of propodeum short, triangle depressed and striate, otherwise punctate, completely covered with short dense pile.* (23) Posterior surface with long caudally-directed setae. (24, 25) Marginal cell of forewing narrowly truncate, sometimes weakly appendiculate,

mc/wl = .56 (1 sp.). (27) Hind tibial spur pectinate. (29) Basitibial plate poorly defined on anterior edge, narrowly rounded. (30) Anterior basitarsal brush apparently absent.

METASOMA. *Tergum I with anterior surface depressed, flattened, covered with dense short setae, basally dense upward-curved plumose setae enclose an area above petiole, usually containing large mites.* (32) Ridge joining suprapygidial plate and pygidial plate apparently absent.

Male

HEAD. (35) Antenna long, reaching beyond propodeum, scape short; no plate areas. Flagellomere 2 over twice length of 1, subequal to 10; sc/2 = 1.36, 2/1 = 2.50, 3/1 = 2.14, 10/1 = 2.38 (1 sp.). (36) Labrum transverse, distal process little developed; basal elevation extending across basal area, not notched, as in *Neocorynura* (Fig. 146).

MESOSOMA. (37) *Dorsal surface of middle tibia with dense mat of white pile, obscuring surface.*

METASOMA. (38) Metasoma not elongate, somewhat depressed. (39) Tergum VII rather abruptly convex apically, no gradulus. (40) Anal lip of proctiger without post-anal filaments. (42) *Sternum IV* (Fig. 249) *produced laterally into caudally directed process bearing strong setae at apices; posterior marginal area depressed and shiny centrally, truncate; median patch of short, erect, stout setae on postgradular area.* (43) *Sternum V emarginate, with long plumose setae apically.* (44) Sternum VI normal, weakly notched. (45) Sternum VII not produced posteriorly, bearing fine setae, apodemes strongly recurved. Sternum VIII produced posteriorly into rounded median projection, without setae; laterally joining VII near apices of apodemes. Spiculum narrow (Figs. 299-301).

(46) Gonobase (Figs. 370-374) with narrow ventral bridge, dorsal lobes strongly projecting over gonocoxites. (47) Ventral gonostylus a small medially or apically directed lobe, seta-bearing surface facing anteriorly. Basal process of gonostylus absent; parapenial lobe a thin elongate flap. Dorsal gonostylus an elongate thin flap, projecting medially or anteriorly. (48) Penis valve (Fig. 374) with small ventral prong; thin dorsal crest bordering medial and lateral depressions; valve expanded medially and laterally. (49) Volsella (Fig. 373) rounded basally, apical inner angle slightly produced.

Thectochlora contains one rather unusual medium-sized (about 7 mm) green species, *T. alaris* (Vachal). The mesoscutum and basal area of the propodeum of the female are covered with short dense pile. The female is most unusual in the modification of the first metasomal tergum to form an acarinarium. The green male with orange tibiae and whitish basitarsi can be distinguished externally from other genera by the pronotal and mesoscutal structure, patch of dense pile on the second tibiae, and the externally visible

metasomal sterna. Specimens have been seen from southern Brazil, Paraguay and Argentina.

Moure (1941a) gave additional characteristics of the genus and illustrated the fourth metasomal sternum of the male.

Genus **Augochlora** Smith

Female

HEAD. (Figs. 125-126). (1) *Epistomal sulcus forming acute angle, epistomal lobe protruding into clypeus.* (2) *Clypeus relatively flat, green almost to apex.* (4) Preoccipital ridge carinate. (5, 6) Hypostomal floor, l/w = 1.90 to 2.50, c/1 = .30 to .54 (17 spp.). (7) *Anterior angle of hypostomal carina usually forming sharp right angle or produced into spine.* (8) Inner orbit of compound eye deeply emarginate, w/l = .120 to .168 (18 spp.)*. (11) Distal process of labrum triangular, not narrowed, as long or longer than basal area (Figs. 153, 155, 156). Basal elevation variable, see subgeneric descriptions. (12) Mandible normal, elongate, or bidentate, see subgeneric descriptions. (13) Distal portion of maxilla normal, of moderate length (Fig. 175). Inner strip with narrow scale-like cuticular markings and setae on surface of strip (Fig. 175). (14) Maxillary palpus, p/M = .28 to .39 (27 spp.).

MESOSOMA. (19) Pronotal lateral angle usually slightly produced, forming acute or occasionally obtuse angle (Fig. 192)*. Lateral ridge sharply angled, rarely rounded; dorsal ridge carinate. (20) Mesoscutum not narrowed anteriorly, lip rounded, frequently high*. (22) Basal area of propodeum striate or rugose, sometimes finely so with striae not reaching posterior margin. (24) *Marginal cell of forewing truncate, usually appendiculate,* mc/wl = .52 to .61 (17 spp.). (27) *Hind tibial spur with rounded serrations, basal area raised* (Fig. 214). (29) Basitibial plate well defined on all edges, with distinct rim, narrowly or broadly rounded apically. (30) Anterior basitarsal brush present.

METASOMA. (31) Pseudopygidial area of tergum V normal or with scale-like setae (Fig. 223). (33) *Sternum I normal or produced into median ridge, tubercle, or spine* (Fig. 225). (34) Sternum IV with gradulus (Fig. 250), rarely weakly defined. Sterna and terga otherwise normal.

Male

HEAD. (35) Antenna (Fig. 179) moderately long, no plate areas; sc/2 = 3.20 to 4.90, 2/1 = .82 to 1.75, 3/1 = 1.05 to 2.18, 10/1 = 1.50 to 3.18 (12 spp.)*. (36) Labrum (Fig. 154) with distal process well developed, triangular, subequal in length to basal area; basal elevation extending across basal area, not notched medially.

METASOMA. (39) Tergum VII sharply convex apically, gradulus not defined*. (40) Anal lip of proctiger (Fig. 236) with post-anal filaments. (42-44) Sterna IV to VI (Figs. 251-253) usually normal. Apical margin of VI entire or

weakly notched. (45) Sterna VII and VIII with posterior margins variously produced medially, not bilobed, with or without setae. Apodemes of VII strongly recurved anteriorly. Spiculum narrow. Sternum VIII laterally joining VII far from tips of apodemes (Figs. 302-306).

(46) Gonobase (Figs. 377-383) with narrow ventral bridge, dorsal lobes wide, strongly projecting over gonocoxites. (47) Ventral gonostylus an elongate flattened lobe, with seta-bearing surface facing ventrally; ridge lateral to ventral gonostylus continued dorsally, bearing setae. Basal process of gonostylus present, bearing setae. Dorsal process of gonostylus a simple continuation of lateral ridge. (48) Penis valve (Fig. 379) with ventral prong, without dorsal crest, expanded laterally. (49) Volsella (Fig. 380) quadrate.

*Exceptions

In macrocephalic specimens with enlarged genal areas, the eyes are weakly notched, w/l = .083 to .110 (4 spp.). In two species, the lateral angle of the pronotum is strongly produced (Fig. 194), with the mesoscutum narrowed anteriorly and its lip high and sharply angled or carinate. In one male, the antennae are long and bear plate areas, sc/2 = 1.88. In another male, a gradulus is weakly defined on metasomal tergum VII.

Most *Augochlora* are medium-sized to large bright green bees, although many species are partially or wholly black. The genus is very large, with species from Canada to Argentina. *Augochlora* can be divided into two poorly separated large subgenera and one quite distinct small subgenus. Separation of the former two subgenera is significant principally for biological reasons, as will be described in more detail in a later paper (Eickwort, in preparation).

Subgenus **Augochlora** Smith

Augochlora Smith, 1853. Catalogue of hymenopterous insects in the collection of the British Museum, 1:73. (Type species: *Halictus purus* Say, 1837, designated by Cockerell, 1923.)
Odontochlora Schrottky, 1909, Rev. Mus. La Plata 16:141. (Type species: *Augochlora muelleri* Cockerell, 1900, original designation.)
Oxystoglossa Smith, 1853, Catalogue of hymenopterous insects in the collection of the British Museum 1:83. (Type species: *Oxystoglossa decorata* Smith, 1853, monobasic.)

Female

(1) Epistomal lobe deeply protruding into clypeus. (2) Apex of clypeus normal. (11) Labrum (Fig. 153) with distal process not as wide as basal area; basal elevation transverse, strongly protuberant and rounded. (12) Mandible (Fig. 163) with apex bidentate, subapical tooth produced, outer posterior ridge frequently swollen. (15) Prementum normal, of moderate length and width (Fig. 170), pl/W = .67 to .86, pw/pl = .13 to .21 (13 spp.). (16) Salivary plate normal, V-shaped brace, or well sclerotized without defined brace when glossa very long. (17) *Glossa long to very long, over half as long as prementum,* gl/pl = .58 to .98, gl/W = .39 to .84 (14 spp.)*. (18) Palpal

segments 2 plus 3 subequal to or shorter than 1. (19) Lateral angle of pronotum usually produced and acute, sometimes obtuse. (29) Basitibial plate broadly rounded. (31) *Pseudopygidial area with scale-like setae bordering median slit.* (33) Sternum I with or without median ridge, tubercle, or spine.

Male

(39) Apex of metasomal tergum VII normal. (43-44) Sterna V and VI normal. (45) Sternum VII (Fig. 303) without spiculum-like median anterior sclerotized apodeme. (47) Lateral ridge bordering ventral gonostylus of genitalia (Fig. 377) with short setae. Ventral gonostylus a narrow lobe with unmodified setae, as in Fig. 377. (48) Penis valve without strong lateral extensions joined by dorsal ridge.

*Exception

In one species with an exceptionally long head, the prementum and glossa are also exceptionally long, pl/W = 1.04, gl/pl = 1.71, and gl/W = 1.79.

Females of *Augochlora s. s.* are most readily placed in this subgenus by the bidentate mandibles and normal truncate clypeus. The spine on the first metasomal sternum is frequently absent. Species of *Augochlora s. s.* tend to be bluish-green or partially or wholly black, in contrast to most *Oxystoglossella.*

Smith's (1853) original *Augochlora* included many diverse augochlorine bees, characterized by bright green coloration and deeply emarginate eyes. Many of Smith's *Augochlora* species are today considered *Augochloropsis,* and the name *Augochlora* was usually reserved by early authors for bees today placed in that genus. Schrottky (1909a) named *Odontochlora* for those species with a simple tibial spur and spined first metasomal sternum, and he (1909b) widened *Oxystoglossa* to include similar species without an armed first sternum. Although Vachal (1911) rejected this separation, *Odontochlora* and *Oxystoglossa* were widely used to include species now placed in *Augochlora,* until Cockerell (1923) designated *Augochlora pura* (Say), a species of *Odontochlora,* as type species of *Augochlora.* Sandhouse (1937) synonymized *Odontochlora* and *Oxystoglossa* with *Augochlora* and correctly described the genus, distinguishing it from *Augochloropsis.*

Smith (1853) named *Oxystoglossa* for one Jamaican species, *decorata,* similar to *Augochlora* but with a greatly elongated glossa. Dr. I. H. H. Yarrow of the British Museum (Natural History) kindly loaned the type specimen (a female) of *O. decorata* to me for examination. It is in poor condition and some pertinent characters could not be observed. I place it in *Augochlora s. s.* on the basis of scale-like setae bordering the pseudopygidial median slit and mandibles which more closely resemble those of species of *Augochlora* than of *Oxystoglossella.*

All species of *Augochlora s. s.* which have been investigated biologically

have been found to nest in wood. This large subgenus includes such species as *Augochlora pura* (Say) (North America), *A. nigrocyanea* Cockerell and *A. smaragdina* Friese (Mexico and Central America), and *A. esox* (Vachal) and *A. muelleri* Cockerell (South America).

Subgenus **Oxystoglossella,** new subgenus
(Type species: *Augochlora cordiaefloris* Cockerell, 1907.)

Female

(1) Epistomal lobe deeply protruding into clypeus. (2) Apex of clypeus normal. (11) Labrum (Fig. 156) with distal process not as wide as basal area; basal elevation suborbicular, strongly protuberant and rounded*. (12) Mandible normal*. (15) Prementum normal, of moderate length and width, pl/W = .70 to .89, pw/pl = .14 to .18 (10 spp.). (16) Salivary plate normal with V-shaped brace, or well sclerotized without defined brace when glossa very long. (17) *Glossa usually long, usually over .75 as long as prementum,* gl/pl = .71 to .92, gl/W = .53 to .79 (10 spp.). (18) Palpal segments 2 plus 3 equal to or shorter than 1. (19) Lateral angle of pronotum usually produced and acute, occasionally obtuse. (29) Basitibial plate usually narrowly rounded, occasionally broadly rounded. (31) No scale-like setae on pseudopygidial area. (33) Sternum I usually normal, rarely with slight median ridge or tooth.

Male

(39) Apex of metasomal tergum VII normal. (43, 44) Sterna V and VI normal. (45) Sternum VII (Fig. 305) without spiculum-like median anterior sclerotized apodeme. (47) Lateral ridge bordering ventral gonostylus with very long setae, surpassing gonostylus (Fig. 381). Ventral gonostylus a narrow lobe with unmodified setae, as in *Augochlora s. s.* (48) Penis valve without lateral extensions joined by dorsal ridge.

*Exceptions

In four species examined, the females are highly polymorphic in head size, as described by Sakagami and Moure (1965) for *Augochlora semiramis* (Schrottky). The macrocephalic individuals have greatly expanded genae and vertices and shallowly emarginate eyes. In these, the basal elevation of the labrum tends to be very low and transverse, and the distal process as wide as the basal area, and the mandibles are greatly elongated (Fig. 164). The male antennae of one species of this group are exceptionally long and bear plate areas, as mentioned in the exceptions to the generic description.

Members of *Oxystoglossella* closely resemble *Augochlora s. s.,* but are usually more yellowish-green, rarely black, although there is wide color overlap. Females are best separated by mandibular characteristics; males cannot readily be separated from *Augochlora s. s.* without dissection. Revisionary

studies of *Augochlora s. l.* may lead to synonymizing *Oxystoglossella* with *Augochlora s. s.* Both subgenera contain many species; *Oxystoglossella* barely reaches southwestern United States while *Augochlora s. s.* ranges into Canada.

Species of *Oxystoglossella* have previously been placed in *Oxystoglossa,* but subgenerically *Oxystoglossa* appears to be synonymous with *Augochlora s. s.,* based on examination of the type species. I have selected a well known and easily recognizable Mexican and Central American species whose nest structure is known (Eickwort and Eickwort, in preparation) as type species of *Oxystoglossella.*

All species of *Oxystoglossella* which have been investigated biologically have been found to be soil-nesting. This subgenus includes such species as *Augochlora aztecula* Cockerell and the *A. clarki* Michener group (Michener, 1954) (Mexico and Central America), and *A. thalia* Smith (South America).

Subgenus **Mycterochlora,** new subgenus
(Type species: *Halictus repandirostris* Vachal, 1911.)

Female

(1) Epistomal sulcus forming an angle only slightly more acute than a right angle, epistomal lobe not deeply protruding into clypeus. (2) *Apex of clypeus prolonged beyond marginal area, rounded and slightly upturned, covering half of labral basal area.* (11)Distal process of labrum (Fig. 155) as broad as basal area; basal elevation transverse, on apical half of basal area only. (12) Mandible bidentate at apex, subapical tooth produced as in *Augochlora s. s.,* outer posterior ridge not swollen. (15) Prementum normal, comparatively shorter and wider, pl/W = .54 to .56, pw/pl = .22 to .25 (3 spp.). (16) Salivary plate normal, V-shaped brace. (17) Glossa comparatively shorter, about half as long as prementum, gl/pl = .43 to .50, gl/W = .23 to .27 (3 spp.). (18) Palpal segments 2 plus 3 longer than 1. (19) Lateral angle of pronotum not produced, forming obtuse angle (Fig. 193). (29) Basitibial plate very broadly rounded. (31) Pseudopygidial area of metasomal tergum V with scale-like setae bordering median slit, as in *Augochlora s. s.* (33) Sternum I not armed.

Male

(39) Apex of metasomal tergum VII flanged outwards, appearing carinate. (43, 44) Sterna V and VI with strong depressions apically, bordered by row of strong setae on VI and with median ridge at base of concavity on V, small acrosternite present on VI. (45) Sternum VII (Fig. 306) with short well-sclerotized median anterior apodeme, homologous in position with spiculum of VIII but joined by membrane to VII. Spiculum on VIII normal. (47) Lateral ridge bordering ventral gonostylus (Fig. 382) very narrow, with short setae. Ventral gonostylus a broad flat lobe with short stout setae near

apex. (48) Penis valve (Fig. 383) with lateral extensions joined by V-shaped dorsal ridge.

Mycterochlora is a distinctive subgenus of two or three species known from Brazil, Peru, Bolivia, Colombia, and Guyana. The females are quite different in general appearance from *Augochlora s. s.,* with femora, tibiae, and basitarsi broadened and densely clothed with setae. The legs of the males are also broad. Females can easily be recognized by the clypeus. The male of *Augochlora repandirostris* is easily distinguished by the testaceous last visible metasomal tergum with a produced carinate margin, contrasting strongly with the other dark brown terga. I have not seen males of other species.

While this group has never been recognized formally, Vachal (1911) noted the unique condition of the female clypeus and described two species, *Halictus repandirostris* and *H. pachytes,* in the *Halicti falcati.* I have not seen the types of either species, but a series available to me agrees exactly with the description of *Augochlora repandirostris* (Vachal) and forms the basis for the subgeneric description.

Derivation of *Mycterochlora:* Beak or nose, plus root (reference to *Augochlora*), in reference to the clypeus of the female (feminine).

Genus **Augochlorella** Sandhouse

Augochlorella Sandhouse, 1937, J. Washington Acad. Sci. 27:66. (Type species: *Augochlora gratiosa* Smith, 1853, original designation.)

Oxystoglossidia Moure, 1943, Rev. Entomol. (Rio) 14:473. (Type species: *Oxystoglossidia uraniella* Moure, 1943, original designation.)

Female

HEAD (Fig. 127). (1) *Epistomal sulcus forming right angle.* (4) Preoccipital ridge sharply angled or weakly carinate. (5, 6) Hypostomal floor, l/w = 1.33 to 1.49; c/l = .13 to .38 (4 spp.). (8) Inner orbit of compound eye deeply emarginate, w/l = .134 to .159 (4 spp.). (11) Labrum (Fig. 157) with distal process triangular, usually narrower than basal area; basal elevation suborbicular to transverse, rounded and protuberant*. (13) Distal portion of maxilla normal, inner strip with narrow scale-like cuticular markings and setae on edge of strip. (14) Maxillary palpus, p/M = .33 to .43 (6 spp.). (15) Prementum normal, pl/W = .65 to .79, pw/pl = .17 to .20 (6 spp.). (16) Salivary plate normal, V-shaped brace. (17) Glossa about half length of prementum, gl/pl = .46 to .60, gl/W = .30 to .47 (6 spp.).

MESOSOMA. (19) Pronotal lateral angle not produced, forming obtuse or right angle*. Dorsal ridge strongly carinate; lateral ridge sharply angled. (20) Mesoscutum not narrowed anteriorly, lip usually broadly rounded*. (22) Basal area of propodeum striate or rugose, striae occasionally not reaching posterior margin, not granular. (24, 25) *Marginal cell of forewing acute* (Fig. 20), rarely narrowly truncate, mc/wl = .54 to .61 (4 spp.). (27) *Hind*

tibial spur with rounded serrations, basal area raised, as in *Augochlora* (Fig. 214). (29) Basitibial plate well-defined on all edges, narrowly rounded. (30) Anterior basitarsal brush poorly defined.

Male

HEAD. (35) Antenna moderately long, flagellomere 2 very short, much wider than long; no plate areas; sc/2 = 4.89 to 5.88, 2/1 = .76 to .95, 3/1 = 1.09 to 1.10, 10/1 = 2.09 to 2.73 (3 spp.). (36) Labrum with distal process well developed, triangular, usually shorter than basal area; basal elevation extending across basal area, not notched medially; similar to *Augochlora* (Fig. 154).

METASOMA. (39) Tergum VII sharply convex apically, gradulus not or weakly defined. (40) Anal lip of proctiger with post-anal filaments. (42-44) Sterna IV to VI normal, not modified. Apical margin of VI notched, slight median longitudinal ridge sometimes present. (45) Sternum VII variously produced posteriorly, not bilobed, usually with setae; apodemes slightly recurved. Sternum VIII not or slightly produced posteriorly; usually without apical setae; laterally joining VII at apices of apodemes. Spiculum narrow (Figs. 307-309).

(46) Gonobase (Figs. 384-387) with narrow ventral bridge, dorsal lobes strongly or weakly projecting over gonocoxites. (47) Ventral gonostylus of two parts, a posterior-lateral, rounded, seta-bearing lobe and an inner lobe bearing row of flattened modified setae on margin; inner lobe variously shaped, often long and narrow. Basal process of gonostylus absent. Dorsal gonostylus a variously shaped membranous flap projecting from inner edge of ridge, occasionally a long thin flap reaching midline. (48) Penis valve (Fig. 387) with ventral prong; without dorsal crest but with median dorsal ridge bordering depression on inner side; variously expanded laterally and medially. (49) Volsella (Fig. 386) pointed basally, triangular below notch.

*Exceptions

In *Augochlorella edentata* Michener, the female labrum resembles that of *Pereirapis* (Fig. 158), the teeth on the distal process being very strong and the basal elevation apical and very low. In one species observed, the pronotal lateral angles are somewhat produced and the mesoscutal lip rather high. In one male, the antennae are exceptionally short, 2/1 = .46, 3/1 = .51, and 10/1 = 1.91.

Species of *Augochlorella* are usually bright green, medium to small in size, and closely resemble many species of *Augochlora (Oxystoglossella),* from which they can be distinguished by the epistomal sulcus and marginal cell apex. The male genitalia in particular justify regarding *Augochlorella* as a separate genus. *Augochlorella* is distinguished from the closely related

Pereirapis and *Ceratalictus* in discussions of these genera. *Augochlorella edentata* Michener, considered somewhat intermediate between *Pereirapis* and *Augochlorella* by Ordway (1966), is a true *Augochlorella,* intermediate only in its small size and female labrum. About 15 species of *Augochlorella* have been recorded (Ordway, 1966), from Canada to Argentina.

Sandhouse (1937) named *Augochlorella* for four species of North American bees and described the genus in detail, differentiated it from *Augochlora* and *Augochloropsis,* provided a key and descriptions of the North American species, and illustrated the genitalia. Michener (1944, 1951) at first considered *Augochlorella* to be a subgenus of *Augochlora,* but later (1954) returned it to generic rank. Moure (1943) named *Oxystoglossidia* for two South American species, not having seen Sandhouse's paper. After obtaining the paper and specimens of the type species of *Augochlorella,* he (Moure, 1944a) synonymized *Oxystoglossidia* with *Augochlorella.*

Ordway (1966) has recently revised the eight North American and Mexican species of *Augochlorella.* She presented diagnostic characters for the genus, separated it from other North American (north of Mexico) green halictid genera and illustrated the male genitalia and hidden sterna and terga of North American *Augochlorella.*

Well known species of *Augochlorella* include *A. striata* (Provancher) from North America, *A. pomoniella* (Cockerell) from the United States, Mexico, and Central America, and *A. urania* (Smith) from South America.

Genus **Ceratalictus** Moure

Ceratalictus Moure, 1943, Rev. Entomol. (Rio) 14:463. (Type species, *Oxystoglossa theia* Schrottky, 1911, original designation.)

Female

HEAD (Fig. 124). (1) *Epistomal sulcus forming obtuse angle.* (4) Preoccipital ridge carinate. (5, 6) Hypostomal floor longer than wide, l/w = 1.11, c/l = 0 (1 sp.). (8) Inner orbit of compound eye deeply emarginate, w/l = .154 (1 sp.). (11) Labrum with distal process triangular, basal elevation suborbicular, protuberant, as in *Augochlorella* (Fig. 157). (13) Distal process of maxilla normal, inner strip with narrow scale-like cuticular markings. (14) Maxillary palpus, p/M = .40 (1 sp.). (15) Prementum normal, pl/W = .57, pw/pl = .25 (1 sp.). (16) Salivary plate normal, V-shaped brace. (17) Glossa rather short, gl/pl = .30, gl/W = .17 (1 sp.).

MESOSOMA. (19) Pronotal lateral angle produced, forming acute angle. Dorsal ridge carinate; lateral ridge sharply angled. (20) Mesoscutum not narrowed anteriorly, lip high and rounded. (22) Basal area of propodeum striate. (24, 25) *Marginal cell of forewing acute or very narrowly truncate,* mc/wl = .54 (1 sp.). (27) *Hind tibial spur* (Fig. 215) *with rounded serrations, basal area not raised.* (29) Basitibial plate poorly defined on anterior

edge, narrowly rounded or pointed. (30) Anterior basitarsal brush poorly defined.

METASOMA. (31-34) Terga and sterna normal, sternum IV with gradulus defined basally.

Male

HEAD. (35) Antenna moderately long, flagellomere 2 not narrowed, almost as long as wide; no plate areas, sc/1 = 2.85, 2/1 = .98, 3/1 = 1.25, 10/1 = 1.79 (1 sp.). (36) Labrum with distal process well developed, triangular, basal elevation extending across basal area, not notched medially; similar to *Augochlora* (Fig. 154).

METASOMA. (39) Tergum VII sharply convex apically, gradulus not defined. (40) Anal lip of proctiger without post-anal filaments (Fig. 233). (42-44) Sterna IV to VI normal, not modified, as in *Augochlorella*. Apical margin of VI weakly notched. (45) Sternum VII not produced posteriorly, apodemes bent strongly anteriorly. Sternum VIII medially produced, apices VII and VIII bear setae. Sternum VIII laterally joins VII far from apodemes. Spiculum narrow (Figs. 310-312).

(46) Gonobase (Figs. 388-392) with narrow ventral bridge, dorsal lobes wide and strongly projecting over gonocoxites. (47) Ventral gonostylus of two parts, a posterior-lateral rounded seta-bearing lobe and a large lobe with seta-bearing surface facing inward (Fig. 391). Small membranous parapenial lobe present; basal process of gonostylus present, bearing setae. Dorsal gonostylus a long thin transparent flap, reaching midline. (48) Penis valve (Fig. 390) with small ventral prong, longitudinal dorsal ridge apical to dorsal depression, valve slightly expanded laterally. (49) Volsella (Fig. 392) with notch near base, base almost truncate.

The two described species of *Ceratalictus* are medium-sized green bees very closely resembling *Augochlorella*. The difference between *Ceratalictus* and that genus center primarily in the male hidden sterna and terga and the genitalia, and it is a matter of choice whether *Ceratalictus* should be given separate generic status or considered a subgenus of *Augochlorella*. Females of *Ceratalictus* can be distinguished with difficulty from *Augochlorella* by the obtusely angled epistomal sulcus and the tibial spur. Males without dissection are also difficult to distinguish; the antennae, entirely green clypeus (yellow-margined in *Augochlorella*), and more narrowly elongate metasoma are aids. Moure (1950) gave other characteristics to separate *Ceratalictus* from the species of *Augochlorella* and *Pereirapis* occurring in its range. *Ceratalictus* is known from southern Brazil, Paraguay, Bolivia and Argentina.

Moure (1943) named *Ceratalictus* in a key, but did not describe it fully until later (Moure, 1950), when he was able to associate the sexes. He then separated it in a key from related genera and named a second species, *C. allostictus* Moure.

Genus **Pereirapis** Moure

Pereirapis Moure, 1943, Rev. Entomol. (Rio) 14:461. (Type species: *Pereirapis rhizophila* Moure, 1943, original designation.)

Female

HEAD. (1) *Epistomal sulcus forming right or slightly obtuse angle.* (4) Preoccipital ridge sharply angled or carinate. (5, 6) Hypostomal floor longer than wide, l/w = 1.20 to 1.42, c/l = .12 to .34 (3 spp.). (8) Inner orbit of compound eye deeply emarginate, w/l = .125 to .168 (3 spp.). (11) *Labrum* (Fig. 158) *with distal process triangular, projecting laterally from beneath triangular basal area, teeth between fimbria long; basal elevation apical and low.* (13) Distal portion of maxilla normal, inner strip with narrow scale-like cuticular markings. (14) Maxillary palpus, p/M = .39 to .41 (3 spp.). (15) Prementum normal, pl/W = .65 to .70, pw/pl = .18 to .20 (3 spp.). (16) Salivary plate normal, V-shaped brace. (17) Glossa less than half length of prementum, gl/pl = .34 to .42, gl/W = .49 to .55 (3 spp.).

MESOSOMA. (19) Pronotal lateral angle not produced, forming obtuse or right angle*. Dorsal ridge carinate; lateral ridge sharply angled*. (20) Mesoscutum not narrowed anteriorly, lip broadly rounded. (22) *Basal area of propodeum striate basally, strongly granular, long.* (24, 25) *Marginal cell of forewing acute,* mc/wl = .49 to .55 (3 spp.). (27) *Hind tibial spur with few short rounded teeth, basal tooth largest* (Fig. 216). (29) Basitibial plate well defined on all edges, narrowly rounded. (30) Anterior basitarsal brush apparently absent.

METASOMA. (31-34) Terga normal, setae sparse bordering median slit of pseudopygidial area. Sterna IV and usually V with gradulus defined basally.

Male

HEAD. (35) Antenna moderately long, no plate areas, sc/2 = 3.36 to 4.61, 2/1 = .70 to 1.08, 3/1 = 1.19 to 1.53, 10/1 = 1.80 to 2.19 (4 spp.). (36) Labrum with distal process well developed, triangular, usually shorter than basal area; basal elevation extending across basal area, not notched medially; similar to *Augochlora* (Fig. 154).

METASOMA. (39) Tergum VII sharply convex apically, gradulus not or weakly defined. (40) Anal lip of proctiger without post-anal filaments. (42) *Sternum IV* (Fig. 254) *emarginate apically, with posterior-lateral clumps of long flattened setae,* similar setae occasionally also on postgradular area. (43, 44) Sterna V and VI normal, apical margin of VI (Fig. 255) produced medially and notched, dorso-lateral areas of VI wide. (45) Sternum VII not produced medially and projecting beyond sternum VIII, usually bearing setae. Sternum VIII slightly produced medially, bearing few or no setae, joining VII laterally before apices of apodemes*. Spiculum narrow (Fig. 313).

(46) Gonobase (Figs. 393-396) with narrow ventral bridge, dorsal lobes wide and strongly projecting over gonocoxites. (47) Ventral gonostylus of two parts, a posterior-lateral lobe bearing setae and an apically directed inner lobe bearing unmodified setae on its ventral surface. Basal process of gonostylus present, bearing setae*. Dorsal gonostylus a thin, transparent, medially directed flap bearing a darkly pigmented strip*. (48) Penis valve (Fig. 395) without well-developed ventral prong; without dorsal crest but with median longitudinal ridge; expanded medially and laterally*. (49) Volsella (Fig. 396) rounded basally, notch near apex*.

*Exceptions

A unique male specimen from Brazil differs significantly from typical *Pereirapis* in several respects. The pronotal lateral angle is produced and acute, and the lateral ridge carinate. The propodeum (male) is weakly roughened basally and shiny posteriorly. Sternum VIII joins VII at the apices of the apodemes and VII is not strongly curved anteriorly. The basal process of the gonostylus is absent. The dorsal gonostylus is basically typical of the genus but greatly expanded, reaching the midline. The penis valve appears to bear a ventral prong. The volsella is notched medially and appears to be prolonged basally, not rounded.

Species of *Pereirapis* seen by me are very small (about 5 mm) and green with the metasoma usually largely brown. The genus is closely related to *Augochlorella,* separated principally on male metasomal and genitalic characters. The females of *Pereirapis* can be separated from those of *Augochlorella* by the tibial spurs, labrum, granular long propodeum, and usually smaller size; *Augochlorella edentata* Michener is the same size as *Pereirapis* and bears a similar labrum. Males are difficult to distinguish externally from *Augochlorella;* the abdomen is more narrowly elongate, and the bees are smaller than most *Augochlorella*. Dissection reveals the modified fourth metasomal sternum and different genitalia. *Pereirapis* is a rather small genus with about seven species (Moure, in Ordway, 1966) recorded from Mexico to Brazil.

Moure (1943) named *Pereirapis* for a Brazilian species, and separated it from *Augochlorella* (calling the latter *Oxystoglossidia*) in a key. He gave further separating characters in a later key (Moure, 1950) to the *Halicti falcati* of Vachal. Michener (1954) synonymized *Pereirapis* with *Augochlorella*. Ordway (1966) thought that *Pereirapis* represents a legitimate group and perhaps should be recognized at the subgeneric level in *Augochlorella*.

Genus **Pseudaugochloropsis** Schrottky

Augochloropsis (Pseudaugochloropsis) Schrottky, 1906, Z. Syst. Hymenopter. Dipter. 6:313. (Type species: *Halictus nigromarginatus* Spinola, 1851, designated by Schrottky, 1909b.)
Caenaugochlora (Pseudaugochlora) Michener, 1954, Bull. Amer. Mus. Natur. Hist. 104:77. (Type species: *Halictus nigromarginatus* Spinola, 1851, original designation.)

Female

HEAD. (1) Epistomal sulcus forming right angle. (4) *Preoccipital ridge rounded, vertex produced to rounded ridge above ocelli* (Fig. 3). (5, 6) Hypostomal floor over 1.5 times longer than wide, l/w = 1.84 to 2.10, c/l = .40 to .43 (2 spp.). (7) Posterior flange projects beyond occiput (Fig. 4). (8) Inner orbit of compound eye strongly emarginate, w/l = .139 to .186 (3 spp.). (11) Labrum with distal process triangular, narrower than basal area; basal elevation suborbicular, strongly protuberant with apical face flattened (Figs. 7-8). (13) *Distal portion of maxilla with apex of galea pointed, well-sclerotized* (Fig. 21), inner strip with narrow scale-like cuticular markings and surface with long setae. Maxilla (Figs. 19-20) long and slender. (14) Maxillary palpus, p/M = .29 to .31 (3 spp.). (15) *Prementum* (Figs. 23-25) *with anterior surface flattened, premental thickenings absent,* long and slender, pl/W = .64 to .72, pw/pl = .11 (3 spp.). (16) Salivary plate (Fig. 27) well sclerotized, V-shaped brace not apparent. (17) *Glossa very long,* gl/pl = .68 to .75, gl/W = .46 to .50 (3 spp.). (18) Labial palpus with segment 1 flattened, longer than 2 plus 3.

MESOSOMA. (19) Pronotal lateral angle not produced, obtuse (Fig. 32). Dorsal ridge strongly carinate; lateral ridge rounded. (20) Mesoscutum not narrowed anteriorly, lip broadly rounded. (22) Basal area of propodeum with anastomosing rugae. (24, 25) Marginal cell of forewing (Fig. 37) narrowly truncate and appendiculate, mc/wl = .58 to .62 (3 spp.). (27) *Hind tibial spur pectinate* (Fig. 53). (29) Basitibial plate narrowly rounded, all edges defined (Fig. 46). (30) Anterior basitarsal brush well defined (Fig. 50).

Male

HEAD. (35) *Antenna moderately long, terminal flagellomere hooked* (Fig. 79), plate areas present or absent. Scape short, flagellomeres 2-10 nearly equal, much longer than 1; sc/2 = 2.25 to 2.89, 2/1 = 1.72 to 2.54, 3/1 = 1.69 to 2.49, 10/1 = 1.85 to 2.86 (3 spp.). (36) Labrum (Fig. 81) with distal process well developed, triangular; basal elevation notched medially, located only centrally.

METASOMA. (39) Tergum VII (Figs. 94-95) abruptly convex apically, gradulus present or absent. (40) Anal lip of proctiger (Fig. 96) with post-anal filaments. (42) *Sternum IV* (Fig. 101) *with modified apical margin depressed posterior to strong ridge, bearing distinctive lateral or median tufts of long setae.* (43) *Sternum V* (Fig. 102) *with modified apical margin, usually bearing lateral tufts of setae, postgradular area variously ridged and depressed.* (44) Sternum VI (Fig. 103) strongly depressed apically, notched medially. (45) Sternum VII with posterior-lateral corners strongly produced and pointed, apodemes recurved anteriorly. Sternum VIII with truncate or rounded median posterior projection bearing long, strong setae; laterally joining VII far from apodemes. Spiculum moderately broad (Figs. 104-106).

(46) Gonobase (Figs. 107-111) with narrow or membranous ventral bridge, dorsal lobes slightly produced. (47) Ventral gonostylus a caudally directed seta-bearing lobe, with thickened setae on inner edge. Parapenial lobe a thin transparent flap; basal process of gonostylus absent. Dorsal gonostylus with long setae above gonocoxite, produced into ventrally-facing flattened surface, medial to and more or less above ventral gonostylus. (48) Penis valve (Fig. 111) without ventral prong, with strong, darkly pigmented crest apical to dorsal depression. (49) Volsella (Fig. 110) emarginate on inner edge, notch near apex, base not narrowed.

Pseudaugochloropsis is a small but widespread genus of moderately large to large bees. Most species are green, although some have black forms (Eickwort, 1967) or are partly reddish. In females, the mesoscutum is distinctly punctate, the propodeal basal area completely rugose, the supraclypeal area sharply beveled, and the head distinctly wider than long with a pronounced ridge above the ocelli. Males are quickly distinguished by the hooked antennae; the setal patterns on sterna IV and V vary but are usually recognizable as modifications of the type illustrated. *Pseudaugochloropsis* appears to be related to *Caenaugochlora,* from which it is distinguished in the discussion of that genus. Species of *Pseudaugochloropsis* are known from Texas to Argentina.

Schrottky (1906) named *Pseudaugochloropsis* for the *Halicti sericei* of Vachal, characterizing it simply as *Augochloropsis* without setal borders ("Haarbinden") on the apical margins of the abdominal segments. At the time he mentioned only two species specifically, both of them described as new. He later (Schrottky, 1909b) designated *Augochlora nigromarginata* (Spinola) as type species, a species which he did not specifically mention in 1906, but which was in the *Halicti sericei* and therefore included by implication. Sandhouse (1937) considered this designation invalid and designated *Augochloropsis sthena* Schrottky, described as a new species in *Pseudaugochloropsis* in 1906, as type species. However, *A. sthena* is a true *Augochloropsis,* as pointed out by Michener (1954). Moure (1944a) disagreed with Sandhouse, pointing out that Schrottky named his subgenus for the *Halicti sericei,* to which *Halictus nigromarginatus* belongs.

Moure (1941a) first accurately characterized *Pseudaugochloropsis,* restricting it to *nigromarginatus.* Most species previously placed in *Pseudaugochloropsis* actually belong in *Augochloropsis.*

Michener (1954) followed Sandhouse's designation of type species and thus synonymized *Pseudaugochloropsis* with *Augochloropsis.* He created the name *Pseudaugochlora* to replace *Pseudaugochloropsis* as used by Moure, and recognized its relation to *Caenaugochlora* by making it a subgenus of the latter. Moure (1946) again argued for the validity of *Pseudaugochloropsis* in

the present sense, a view which Michener has since accepted (see Michener and Kerfoot, 1967).

The only well-known species of *Pseudaugochloropsis* is *P. graminea* (Fabricius), synonymous with *P. nigromarginatus* (see Moure, 1960b).

Genus **Caenaugochlora** Michener

Female

HEAD. (1) *Epistomal sulcus forming right angle.* (4) *Preoccipital ridge sharply angled or carinate**. (5,6) Hypostomal floor longer than wide, l/w = 1.12 to 1.76, c/l = 0 to .59 (3 spp.). (8) Inner orbit of compound eye strongly emarginate, w/l = .123 to .173 (6 spp.). (11) Labrum with distal process triangular, narrower than basal area; basal elevation suborbicular to elongate, strongly protuberant; see subgeneric descriptions. (12) Mandible normal*. (13) Distal portion of maxilla normal, inner strip with narrow scale-like cuticular markings and long setae on edge. (14) Maxillary palpus, p/M = .33 to .44 (8 spp.). (15) Prementum normal, pw/pl = .17 to .19, pl/W = .64 to .86 (9 spp.). (16) Salivary plate well sclerotized, V-shaped brace not apparent*. (17) Glossa long to very long, usually over 1/2 length of prementum, gl/pl = .44 to 1.24, gl/W = .31 to 1.06 (9 spp.).

MESOSOMA. (19) Pronotal lateral angle produced, forming rounded or sharp acute angle, or not produced, forming obtuse angle. Lateral ridge usually sharply angled, rarely rounded or carinate. Dorsal ridge carinate. (20) Mesoscutum not narrowed anteriorly, lip rounded. (22) Basal area of propodeum variously roughened, usually with weak plicae basally, smooth apically, or completely striate, rarely strongly so. (24, 25) Marginal cell of forewing usually narrowly truncate and appendiculate, as in *Pseudaugochloropsis* (Fig. 37), rarely acute; mc/wl = .61 to .66 (5 spp.). (30) Anterior basitarsal brush weakly defined.

METASOMA. (34) Sterna IV and often V with gradulus defined basally.

Male

HEAD. (35) Antenna moderately long, reaching scutellum, no plate areas. Flagellomere 2 usually slightly longer than 1, rarely 2 about 1.5 times 1, flagellomeres increase in length distally, sc/2 = 2.36 to 5.62, 2/1 = .68 to 1.48, 3/1 = 1.08 to 1.62, 10/1 = 1.24 to 2.11 (6 spp.). (36) Labrum with distal process well developed, triangular; basal elevation extending across basal area, weakly notched medially or entire.

METASOMA. (39) Tergum VII abruptly convex apically, post-gradular area sometimes somewhat indented and flattened; gradulus defined, sometimes weakly so, rarely absent. (40) Anal lip of proctiger without post-anal filaments*, usually with cuticular striations or markings. (41) Apical margin

of sternum III indented medially. (42) Sternum IV with distinctive median patches of setae, see subgeneric descriptions. (43) Sternum V with apex emarginate, rarely lobed lateral to emargination or medially; without distinctive clumps of setae. (44) Sternum VI weakly notched apically, median portion of postgradular area shiny, depressed, without setae, often with low longitudinal ridge. *Sterna V and VI frequently with narrow acrosternite, sternum VI frequently with small sclerotized median apodeme attached by membrane to acrosternite, homologous in position with spiculum**. (45) Sternum VII posteriorly slightly to strongly prolonged into rounded or truncate lobe, usually bearing short setae; apodemes recurved anteriorly. *Median well-sclerotized apodeme connected by membrane to sternum VII, extending anteriorly and overlapping spiculum*. Sternum VIII with posterior margin bearing no or few setae, see subgeneric descriptions; spiculum narrow; sternum VIII joining VII at apices of apodemes (Figs. 314-317).

(46) Gonobase (Figs. 397-402) with narrow ventral bridge, dorsal lobes slightly produced. (47) Ventral gonostylus a flattened seta-bearing lobe, continued anteriorly on inner edge of gonocoxite to level of volsella. Basal process of gonostylus absent. Dorsal gonostylus variable, see subgeneric descriptions. (48) Penis valve (Fig. 399) with ventral prong; rounded dorsal crest not sharply delineated from anterior dorsal surface of valve; inner flange variously developed medial to crest; lateral flange rarely developed. (49) Volsella (Fig. 400) with notch near apex, base more or less rounded or truncate; see subgeneric descriptions.

*Exceptions

Caenaugochlora costaricensis (Friese), a comparatively large species, is exceptional in having a gradually rounded preoccipital ridge. The type species of the subgenus *Ctenaugochlora, Caenaugochlora perpectinata* (Michener), is unique in having the pregradular areas of sterna V and VI (Figs. 258-259) greatly expanded, the antecosta being bowed anteriorly. *C. perpectinata* also has only a moderately long glossa, gl/pl = .50, gl/W = .32, with the salivary plate normal, not well defined, and bearing a V-shaped brace. An additional species of *Ctenaugochlora* has very short post-anal filaments on the proctiger, not pigmented or lined with microtrichia. A third species of this subgenus has the subapical tooth and outer posterior ridge of the mandibles of the female produced.

Species of *Caenaugochlora* are variously colored, and usually of moderate size and smaller than *Pseudaugochloropsis*, to which they are apparently most closely related. The quite different male genitalic and metasomal characters, as well as the more normal mouthparts, justify giving *Caenaugochlora* separate generic rank.

Subgenus **Caenaugochlora** Michener

Caenaugochlora (Caenaugochlora) Michener, 1954, Bull. Amer. Mus. Natur. Hist. 104:76. (Type species: *Caenaugochlora macswaini* Michener, 1954, original designation.)

Female

(9) *Compound eye usually bearing long hairs;* hairs rarely short, of normal size. (11) Basal elevation of labrum with proximal surface usually shiny, somewhat indented; rarely shallowly notched. (27) Hind tibial spur pectinate, as in *Pseudaugochloropsis* (Fig. 53). (29) Basitibial plate well defined, edges somewhat raised, narrowly rounded.

Male

(42) *Metasomal sternum IV* (Fig. 256) *bearing 1 or 2 distinctive pairs of setal clumps on raised tubercles, to either side of apical median depression.* Gradulus reaching antecosta medially, antecosta may be interrupted medially; postgradular area may bear specialized setae medially and at gradulus. (45) Posterior margin of sternum VIII (Fig. 314) strongly produced into a rounded, truncate, or slightly bilobed median projection. (47) Dorsal gonostylus (Fig. 398) a transparent thin or membranous longitudinal lobe bearing setae at its apex; lobe projecting from inner margin of dorsal ridge. Volsella emarginate medially, inner apical corner more or less produced.

Typical *Caenaugochlora* frequently resemble *Augochloropsis* in color pattern and size; they can easily be distinguished from the latter genus by the lack of metasomal vibrissae, the normal tegulae, basitibial plate, and epistomal sulcus. *Caenaugochlora costaricensis* (Friese) and its more northern close relatives or color varieties are about the size of *Pseudaugochloropsis graminea* (about 11 mm long) and resemble *Pseudaugochloropsis* closely in general appearance. The long hairs on the eyes of *C. costaricensis* and most smaller species of *Caenaugochlora* separate these bees from *Pseudaugochloropsis* and most other augochlorine genera, although they resemble in this respect *Caenohalictus* (not an augochlorine genus). Females of *Caenaugochlora* are also distinguished from *Pseudaugochloropsis* by the uniformly convex supraclypeal area, usually carinate or sharply angled preoccipital ridge, and usually weakly and obscurely punctured central area of the mesoscutum. Males can be separated externally from bees of most genera by the modifications of metasomal sternum IV; the antennae are not hooked. *Caenaugochlora* is a medium-sized but poorly collected genus, with species known from Mexico to Ecuador.

Michener (1954) proposed *Caenaugochlora* to replace *Caenohalictus* of authors other than Cameron, since the description by Cameron led Michener to believe that *Caenohalictus* was actually a senior synonym of *Rhinetula* Friese. However, an examination of the type species of *Caenohalictus* led Moure (1964) to restore *Caenohalictus* to its original meaning as separate

from *Rhinetula* (see Eickwort, 1967). Neither *Caenohalictus* nor *Rhinetula* are augochlorine genera. However, the series of bees upon which Michener (1954) based his description of *Caenaugochlora* are not *Caenohalictus,* but are actually related to *Pseudaugochloropsis,* as Michener realized.

Michener had proposed *Caenaugochlora s. l.* to include both *Caenaugochlora s. s.* and *Pseudaugochlora,* which he named to replace *Pseudaugochloropsis* as used by Moure (see discussion of *Pseudaugochloropsis*). Accepting Moure's concept of *Pseudaugochloropsis,* I earlier (Eickwort, 1967) tentatively synonymized *Caenaugochlora* with *Pseudaugochloropsis,* using the latter name as a replacement for *Caenaugochlora s. l.* in the sense of Michener (1954). Not having found species intermediate between the two groups, I now consider *Pseudaugochloropsis* and *Caenaugochlora* to be separate genera, although related.

Subgenus **Ctenaugochlora,** new subgenus

(Type species: *Neocorynura perpectinata* Michener, 1954.)

Female

(9) Compound eye with hairs normal, not long. (11) Basal elevation of labrum with surface flattened, roughened, strongly notched. (27) *Hind tibial spur* (Fig. 217) *closely pectinate, over 10 long teeth per spur.* (29) *Basitibial plate only defined posteriorly, obsolescent anteriorly.*

Male

(42) *Metasomal sternum IV* (Fig. 257) *with V-shaped patch of setae bordering slight median depression,* not otherwise modified. (45) Posterior margin of sternum VIII (Fig. 317) not produced; posterior margin of sternum VII broadly produced. (47) Dorsal gonostylus (Fig. 402) a small membranous extension without setae, extending from dorsal ridge which bears setae. (49) Volsella (Fig. 401) not notched on inner margin, inner apical corner not produced.

Caenaugochlora perpectinata is a black species with greenish tints, darkened anterior margins of the forewings, and strongly produced pronotal lateral angles. In general appearance it is strikingly similar to many species of *Neocorynura,* the genus in which it was first placed. The basitibial plate and tibial spur easily separate females of *Ctenaugochlora* from *Neocorynura* and *Caenaugochlora s. s.* Males can most easily be distinguished externally by the fourth metasomal sternum; the metasoma is somewhat elongate, as in *Caenaugochlora s. s.,* but not petiolate.

I have seen an additional green female *Ctenaugochlora* with orange legs and a long head; its mandibles have the subapical tooth and outer posterior ridge produced and the mouthparts are elongate, resembling those of *Caenaugochlora s. s.* In general appearance this specimen more closely resembles

Caenaugochlora s. s. than does *C. perpectinata.* The male of this species is unknown. Another species is known only by the male; the bees are reddish-violet and do not have the pregradular areas of metasomal sterna V and VI expanded in a manner similar to *C. perpectinata* (Figs. 258-259). The mesoscutum of known species of *Ctenaugochlora* is closely and distinctly punctate, unlike *Caenaugochlora s. s.* These three species are the only *Ctenaugochlora* known to me; they are from Costa Rica and Panama.

Derivation of *Ctenaugochlora:* Comb, plus *Augochlora,* in reference to the hind tibial spur of the female (feminine).

Genus **Megalopta** Smith

Megalopta Smith, 1853, Catalogue of hymenopterous insects in the collection of the British Museum 1:83. (Type species *Megalopta idalia* Smith, 1853, by designation of International Commission on Zoological Nomenclature, 1966, Opinion 788, Bull. Zool. Nomenclature 23:211.)

Megalopta (Megaloptella) Schrottky, 1906, Z. Syst. Hymenopter. Dipter. 6:312. (Type species: *Halictus ochrias* Vachal, 1904a, monobasic and original designation.)

Tmetocoelia Moure, 1943, Rev. Entomol. (Rio) 14:481. (Type species: *Megalopta sulciventris* Friese, 1926, original designation.)

Female

HEAD (Figs. 133-134). (1) Epistomal sulcus forming rounded acute angle, thus deeply lobed. Vertex swollen behind ocelli. (4) Preoccipital ridge gradually rounded. (5, 6) Hypostomal floor about 1.5 times as long as wide, l/w = 1.44, c/l = .82 (1 sp.). (7) Posterior flange projects slightly beyond occiput. (8) *Eyes enlarged, inner orbit slightly emarginate, eyes strongly convergent above, separated from lateral ocelli by less than ocellar diameter**; w/l = .082 to .092 (5 spp.). (10) *Ocelli enlarged**. (11) *Labrum* (Fig. 159) *with distal process expanded, as wide as basal area, margins flanged, labral fimbria short and on surface. Distal keel flat-topped basally. Basal area with lateral margins raised and rounded; basal tubercle medially indented.* (12) *Mandible* (Figs. 161-162) *with subapical tooth produced, supplementary teeth on inner surface.* (13) Distal portion of maxilla normal, relatively long and narrow, inner strip with narrow scale-like cuticular markings and abundant long setae on surface of strip. (14) Maxillary palpus, p/M = .31 to .35 (5 spp.). (15) Prementum relatively long and narrow, pl/W = .61 to .81 (4 spp.)*. (16) Salivary plate well sclerotized, similar to that of *Pseudaugochloropsis* (Fig. 27), brace not apparent. (17) Glossa very long, gl/pl = .77 to 1.05, gl/W = .44 to .62 (5 spp.). (18) Palpi normal, segments 2 plus 3 slightly longer than 1.

MESOSOMA. (19) *Pronotal dorsal ridge gradually rounded, very narrow. Anterior edge of lateral angle carinate; lateral ridge carinate and lateral surface striate* (Figs. 195-196). (20) Mesoscutal lip low and rounded. (22) Basal area of propodeum smooth or with weak striae. (24, 25) Marginal cell of fore-

wing long, mc/wl = .62 to .68 (4 spp.). Apex of cell narrowly truncate. *Hamuli numerous, in single closely-spaced series**. (26) Hind tibia with short apical spine. (27) *Hind tibial spur pectinate, teeth slightly flattened and lamellate* (Fig. 220). (29) *Basitibial plate defined only posteriorly* (Fig. 205)*. (30) Anterior basitarsal brush well defined.

METASOMA. (31) Pseudopygidal area clothed with scale-like setae bordering median slit.

Male

HEAD. (35) Antenna moderately long, tip strongly beveled, flagellomere 2 1.25 to 1.5 times length of 1 but slightly shorter than 10, sc/2 = 2.20 to 2.89, 2/1 = 1.23 to 1.49, 3/1 = 1.49 to 1.72, 10/1 = 1.34 to 1.72 (4 spp.). (36) Labrum with triangular distal process, about as long as basal area, basal tubercle not notched and extending across base, similar to that of *Augochlora* (Fig. 154).

METASOMA. (39) Tergum VII abruptly angled apically, with long setae; gradulus absent. (40) Anal lip of proctiger with post-anal filaments, similar to those of *Pseudaugochloropsis* (Fig. 96), or filaments absent. (41) *Sternum III with apical margin bilobed medially, lobes with short strong setae* (Fig. 264), median depression present or absent. (42) *Sternum IV with apical margin notched laterally, bilobed medially; flap projecting medially just posterior to gradulus;* post-gradular area with patches of short setae or more uniformly clothed with long setae; antecosta meeting gradulus medially (Fig. 265). (43) Sternum V (Fig. 266) short and wide, notched medially with apical depression; gradulus broadly joining antecosta. (44) Sternum VI (Fig. 267) short and wide, deeply notched medially, slight longitudinal median ridge, antecosta sometimes absent medially. (45) Sternum VII projecting posterior to sternum VIII, posterior process bilobed and bearing setae, apodemes slightly recurved anteriorly. Sternum VIII with narrow spiculum; posterior median projection little developed, usually bearing setae medially; laterally joining sternum VII near apices of apodemes (Figs. 319-321).

(46) Gonobase (Figs. 403-404) with narrow ventral bridge, dorsal lobes slightly projecting over gonocoxites. (47) Ventral gonostylus a caudally directed lobe with seta-bearing flattened surface facing ventrally; setae also on dorsal surface of lobe. *Parapenial lobe well sclerotized, expanded apically, projecting to midline, ventral to penis valve.* Basal process of gonostylus absent. Dorsal gonostylus a long thin flap, sometimes bearing setae on ventral surface. (48) *Penis valve* (Fig. 405) *with large ventral prong and large, apparently eversible, dorsal crest apical to dorsal depression.* (49) Volsella (Fig. 406) with inner edge notched.

*Exceptions

The eyes and ocelli of one female specimen examined are not enlarged, but rather normal in size, comparable to those of other genera. This same

specimen has a relatively short prementum, pl/W = .42. It also has the hamuli somewhat clumped, and the basitibial plate defined apically and partially anteriorly, as well as posteriorly. According to Moure (1958b), *Megalopta ianthina* Smith and *M. nigrofemorata* Smith, described from the females, also have normal-sized ocelli.

Megalopta is a genus of large to very large bees; most species are nocturnal with enlarged eyes and ocelli. Most species are largely testaceous with abundant green reflections on the head and mesosoma, although one species examined lacks greenish reflections, those parts being brown instead. Representatives of the genus occur from Mexico to Argentina.

Excluding the small-eyed female cited as an exception above, the species available to me can be divided into two species groups. Specimens of one group have a weakly plicate basal area of the propodeum, post-anal filaments on the proctiger of the male, and also differ slightly from the second group in the exposed metasomal sterna and gonostyli of the male. Specimens of the second group have a completely smooth basal area of the propodeum, lack post-anal filaments, and the males bear unusual protuberances near the propodeal spiracles; these bumps are densely covered with short setae so as to appear felt-like. The differences between these groups do not merit subgeneric splitting at present; specimens not available to me may be intermediate or represent other species groups, judging from the descriptions quoted by Friese (1926).

Following its description by Smith (1853), who included two new species (*bituberculata* and *idalia*), *Megalopta* has almost universally been accorded generic status. Unfortunately, *M. bituberculata* Smith was designated as the type species (Cockerell, 1900). It was later discovered that *M. bituberculata* is actually a nomiine bee, belonging to *Reepenia* of the Indo-Australian region and probably mislabeled as coming from Brazil (Michener and Moure, 1964). Moure (1943) proposed the name *Tmetocoelia* for the species normally placed in *Megalopta,* excluding *M. bituberculata.* Later (1958b) he reviewed the nomenclatorial history of *Megalopta* and stated that *M. idalia* Smith should have been considered the type species, as the generic description referred primarily to that species. He named the genus *Megaloptodes* to accommodate *M. bituberculata.* Michener and Moure (1964) petitioned the International Commission on Zoological Nomenclature to use its plenary powers to designate *idalia* as the type species of *Megalopta,* and this request was granted (International Commission on Zoological Nomenclature, 1966). *Tmetocoelia* thereby became a synonym of *Megalopta,* and *Megaloptodes* of *Reepenia.*

Schrottky (1906) named *Megaloptella* as a subgenus of *Megalopta,* for *Megalopta ochrias* (Vachal). He later synonymized it with *Megalopta,* as did Moure (1958b).

Cockerell (1905b) published a key to Smith's species of *Megalopta*, noting that they did not constitute a natural group. Moure (1958b) redescribed Smith's species, leaving 4 species in *Megalopta* and placing the others in other genera.

Friese (1926) published an extensive revision and discussion of *Megalopta*, including the original descriptions of eight previously described species and descriptions of 14 new species. He doubtfully placed *Megaloptella* as a subgenus of *Megalopta*. He doubted the necessity of subdividing *Megalopta* but suggested that head structure and female tibial spur form should be considered in any attempt to do so (Friese included *Megaloptidia* as a synonym of *Megalopta*). He listed 40 species, not all currently placed in *Megalopta*.

Well known species of *Megalopta* include *M. genalis* Meade-Waldo from Central America, and *M. sodalis* (Vachal) and *M. amoena* (Spinola) (= *M. idalia* Smith, according to Sakagami and Moure, 1965) from South America.

Genus **Megommation** Moure

Female

HEAD. (1) Epistomal sulcus forming an approximately right angle. (2) *Clypeus and supraclypeal area strongly bowed outwards,* as in Fig. 129. *Clypeal teeth prominent.* (4) Preoccipital ridge rounded. (5, 6) Hypostomal floor long and narrow. (7) Posterior flange of hypostoma projects beyond occiput. (8) Inner orbit of compound eye moderately emarginate, w/l = .114 to .128 (3 spp.). (10) Ocelli normal to enlarged, see subgeneric descriptions. (11) Labrum with distal process triangular, nearly as wide as basal area but shorter; basal elevation suborbicular, strongly protuberant, apical surface flattened, basal elevation as in labrum of *Pseudaugochloropsis* (Figs. 7-8). (12) *Mandible broad,* as in Fig. 166. (13) *Distal portion of maxilla long and very narrow, as in Ariphanarthra* (Fig. 182). Apex of galea pointed, no apical lobe. Inner strip with long setae on surface. (14) Maxillary palpus of normal length. (15) *Prementum very long and narrow, as in Ariphanarthra* (Fig. 171), pl/W = .61, pw/pl = .06 (1 sp.). (16) Salivary plate well defined, no V-shaped brace. (17) Glossa rather short, as in *Ariphanarthra*, gl/pl = .29, gl/W = .18 (1 sp.). (18) Segments 2 plus 3 of labial palpus shorter than 1.

MESOSOMA. (19) Pronotal lateral angle not produced, obtuse. Dorsal ridge not carinate, weakly defined; lateral ridge rounded. (20) Mesoscutum not narrowed anteriorly, lip low and rounded. (22) *Basal area of propodeum smooth, without striae.* (24, 25) Marginal cell of forewing acute, mc/wl = .57 to .63 (3 spp.). (29) *Basitibial plate very short, little surpassing apex of femur,* well defined on all edges. (30) Anterior basitarsal brush apparently absent.

METASOMA. (32) Suprapygidial plate poorly defined, gradulus absent on tergum VI.

Male

HEAD. (35) Antenna reaching about to scutellum, plate areas present or absent; flagellomere 1 much longer than 2 and subequal to 10; sc/2 = 4.74 to 9.16, 2/1 = .53 to .66, 3/1 = .78 to .80, 10/1 = .97 to 1.17 (2 spp). (36) Labrum with basal area rather long, distal process not or scarcely formed, labrum less than 1.5 times wider than long. Basal elevation strongly protuberant, slightly notched medially or entire, extending across basal area.

METASOMA. (38) Metasoma oval, not elongate. (39) Tergum VII rather abruptly convex apically, no gradulus. (40) Anal lip of proctiger with postanal filaments. (41) Apical margin of sternum III produced and pointed medially. (42) *Sternum IV with row or rows of strong modified setae laterally on postgradular area, bordering gradulus;* gradulus interrupted medially, modified as in Figs. 262 and 263. (43) Sternum V weakly or strongly emarginate medially. (44) Sternum VI weakly notched apically, gradulus slightly notched medially. (45) Sternum VII produced posteriorly, bearing setae; apodemes recurved. Sternum VIII not produced posteriorly, few or no setae; laterally joining VII far from apices of apodemes. Spiculum moderately broad (Figs. 322-323).

(46) Gonobase (Figs. 407-410) with narrow ventral bridge, sharply angled dorsal lobes strongly projecting over gonocoxites. (47) Ventral gonostylus a large lobe broadly joining inner edge of gonocoxite, extending anteriorly to level of top of volsella, bearing setae. Basal process of gonostylus absent. Dorsal gonostylus a large partly membranous lobe, see subgeneric descriptions. (48) Penis valve with ventral prong and strong dorsal crest posterior to more or less well-defined dorsal depression; valve expanded medially and laterally. (49) Volsella indented medially and apically; shallow transverse ridge below notch; base prolonged laterally.

Megommation and its relatives, *Megaloptidia* and *Ariphanarthra,* are characterized by the strongly protuberant clypeus and supraclypeal area and very narrow mouthparts, distinctive without dissection. Species in these genera are rather shiny, weakly and obscurely punctured, with the basal area of the propodeum usually smooth. As a group they are poorly represented in collections.

A male of *Megaloptidia* was unfortunately not available to me for dissection; examination of its genitalic and sternal structures might lead to placing *Megommation* as a subgenus of it. At present I consider *Megommation* to consist of two well-separated subgenera.

Subgenus **Megommation** Moure

Megommation Moure, 1943, Rev. Entomol. (Rio) 14:479. (Type species: *Halictus insignis* Smith, 1853, monobasic and original designation.)

Female (Fig. 128)

(8)Eyes enlarged. (10) *Ocelli enlarged.* (27) *Hind tibial spur serrate, similar to outer spur.*

Male

(37) Inner hind tibial spur curved and rounded at tip. (40) Post-anal filaments of proctiger long. (42) Sternum IV with two pairs of rows of modified setae, extending nearly to posterior margin, posterior margin produced and truncate (Fig. 263). (43) Sternum V with deep rounded emargination posteriorly, gradulus bowed anteriorly and interrupted medially. (45) Sternum VII bilobed posteriorly (Fig. 323). (47) Ventral gonostylus with long stiff modified setae, as in Fig. 407. Small parapenial lobe present. Dorsal gonostylus (Fig. 408) consisting of broad membranous area bordering dorsal projection.

Megommation s. s. contains only the type species, *Megommation insigne* (Smith), a large (about 14 mm) brown species with enlarged ocelli. The ocelli and tibial spurs, as well as the larger size, distinguish *Megommation s. s.* from *Megaloptina. Megommation s. s.* is distinguished from *Megaloptidia* in the discussion of that genus. Specimens of *Megommation s. s.* are known from southern Brazil, Argentina, and Paraguay.

Moure (1943) gave other characteristics of *Megommation sensu stricto.*

Subgenus **Megaloptina,** new subgenus

(Type species: *Augochlora (Pseudaugochloropsis) ogilviei* Cockerell, 1930.)

Female (Fig. 129)

(8) Eyes normal. (10) *Ocelli normal or slightly enlarged.* (27) *Hind tibial spur pectinate* (Fig. 218), *teeth rather short.*

Male

(37) Inner hind tibial spur normal. *Dense patch of plumose setae on lateral surface of propodeum, just posterior to propodeal spiracle.* (40) Post-anal filaments very short and stubby. (42) Sternum IV with single short row of modified setae, not near posterior margin, which is unmodified or produced (Fig. 262). (43) Sternum V weakly emarginate apically, not modified. (45) Posterior margin of sternum VII produced medially, not bilobed (Fig. 322). (47) Ventral gonostylus with short setae, as in Fig. 409. Dorsal gonostylus complex (Fig. 410), an elongate partially membranous lobe projecting over ventral gonostylus, connected to medially projecting clear, thin flap.

Megaloptina is a poorly collected subgenus of medium sized, rather shiny, greenish bees abundantly suffused with brown. Unfortunately, the male of only one species was available to me for dissection, and the male genitalic and

sternal characters are based on this species alone. The tibial spur, more normal-sized eyes and ocelli, protuberant clypeus and supraclypeal area and the greatly narrowed mouthparts externally distinguish *Megaloptina* from any genus with which it could be confused. The clypeus of the male is strongly beveled, similar to that of *Ariphanarthra* but without a dividing carina.

I have seen specimens of five species of *Megaloptina,* but have been able to associate a name with only one species, *Megommation (Megaloptina) ogilviei* (Cockerell) new combination. Judging by the descriptions given by Smith (1879) and Cockerell (1905a), the male of *Augochlora festivaga* Dalla Torre (= *A. festiva* Smith, 1879) from Brazil belongs to *Megommation s. l.* and probably to *Megaloptina.* This species bears unusual tufts of pubescence on the propodeum as does the species I have examined, is medium sized and green but has "gigantic ocelli" (Cockerell, 1905a) and the middle of the apical margin of metasomal sternum IV is produced. Cockerell (1905a, 1930) recognized the unusual nature of *M. festivaga* and *ogilviei* but did not propose separate generic status for them, placing them in *Augochlora.* Species of *Megaloptina* are known from Costa Rica, Colombia, Guyana, Bolivia and Brazil.

Derivation of *Megaloptina:* Diminutive of *Megalopta* (feminine).

Genus **Megaloptidia** Cockerell

Megalopta (Megaloptidia) Cockerell, 1900, Proc. Acad. Natur. Sci. Philadelphia 52:373. (Type species: *Megalopta (Megaloptidia) contradicta* Cockerell, 1900, monobasic and original designation.)

Female

HEAD (Fig. 130). (1) Epistomal sulcus forming an approximately right angle. (2) *Clypeus and supraclypeal area strongly bowed outwards, as in Megommation* (Fig. 129). *Clypeal teeth broad.* (4) Preoccipital ridge rounded. (5, 6) Hypostomal floor long and narrow. (8) Inner orbit of compound eye strongly emarginate, w/l = .148 (1 sp.); *eyes greatly enlarged, projecting above vertex and nearly reaching lateral ocelli and subantennal sulci.* (10) *Ocelli enlarged.* (11) Labrum with distal process triangular, shorter than basal area, basal elevation suborbicular, strongly protuberant, apical face flattened, as in *Megommation.* (12) *Mandible broad, outer posterior ridge produced, as in Ariphanarthra* (Fig. 167). (13) *Distal portion of maxilla long and very narrow, as in Ariphanarthra* (Fig. 182). Apex of galea pointed, no apical lobe. Inner strip with long setae on surface. (14) Maxillary palpus long and slender, apical segments slightly flattened, p/M = .31 (1 sp.). (15) *Prementum very long and narrow, as in Ariphanarthra* (Fig. 171), pl/W = .68, pw/pl = .06 (1 sp.). (16) Salivary plate well defined, no V-shaped brace. (17) Glossa rather short, as in *Ariphanarthra,* gl/pl = .25, gl/W = .17 (1 sp.). (18) Segments 2 plus 3 of labial palpus shorter than 1.

MESOSOMA. (19) Pronotal lateral angle not produced, obtuse. Dorsal ridge not carinate, weakly defined; lateral ridge rounded. (20) Mesoscutum not narrowed anteriorly, lip low and rounded. (22) *Basal area of propodeum smooth, without striae.* (24, 25) *Marginal cell of forewing narrowly truncate and appendiculate, marginal cell long,* mc / wl = .74 (1 sp.). (27) Hind tibial spur serrate. (29) Basitibial plate not short, much surpassing apex of femur, well defined on all edges, narrowly rounded. (30) Anterior basitarsal brush weakly formed.

Male

HEAD. (35) Antenna with flagellomere 1 longer than 2, apical flagellomeres not examined, sc / 2 = 5.50, 2 / 1 = .77 (1 sp.). (36) Labrum with basal area rather long, strongly arched, distal process not or scarcely formed, as in *Megommation.* Basal elevation strongly protuberant, not notched, extending across basal area.

METASOMA. (42) *Sternum IV with posterior margin bilobed, profound median notch, resulting lobes strongly pilose.*[1] (43) Sternum V normal.[1] (44) Sternum VI weakly notched apically.[1]

Megaloptidia contains only the type species, *M. contradicta* (Cockerell). Through the courtesy of Dr. Jerome Rozen, Jr., of the American Museum of Natural History, I have been able to examine a series of females of *Megaloptidia.* This rather large (about 12 mm) species, probably *M. contradicta,* is largely ferruginous brown with slight metallic tints and most closely resembles *Megommation insigne,* from which it can be easily distinguished by the huge eyes projecting above the vertex and by the basitibial plate, and by the bilobed fourth metasomal sternum of the male. The narrow mouthparts will distinguish *Megaloptidia* from any other genera, such as *Megalopta,* with which it could be confused. In lateral view, the head of *Megaloptidia* is quite striking, as it is very narrow, the genae being much narrower than the eyes.

Unfortunately, the only male available to me is lacking the distal portions of the antennae and metasoma. It was borrowed from the Academy of Natural Sciences in Philadelphia and was collected in Santarem, Brazil, and probably formed part of Cockerell's type series. *Megaloptidia* is very similar to *Megommation* and *Ariphanarthra* but their exact relationship cannot be determined until the male terminalia can be studied. *Megaloptidia* is known only from Brazil.

The original subgeneric description of *Megaloptidia* by Cockerell (1900) was very sketchy, describing principally the wing venation. Moure (1958b) described the genus in much greater detail, differentiating it from *Megommation.*

[1] Not examined; as described by Moure (1958b).

Genus **Ariphanarthra** Moure

Ariphanarthra Moure, 1951, Dusenia 2:137. (Type species: *Ariphanarthra palpalis* Moure, 1951, monobasic and original designation.)

Female

HEAD (Figs. 131-132). (1) Epistomal sulcus forming right angle. (2) *Clypeus and supraclypeal area strongly bowed outwards,* as in Fig. 132. Face deeply impressed above supraclypeal area. (4) Preoccipital ridge rounded. (5) Hypostomal floor long and narrow, l/w = 1.89 (1 sp.). (6) Hypostomal bridge broadly joins posterior margin of hypostoma. (8) Inner orbit of compound eye moderately emarginate, w/l = .125 (1 sp.), eyes slightly enlarged. (10) Ocelli slightly enlarged. (11) Labrum with distal process triangular, as wide as basal area but shorter; basal elevation suborbicular, strongly protuberant, apical face flattened, as in *Megommation.* (12) *Mandible broad, outer posterior ridge produced* (Fig. 167). (13) *Distal portion of maxilla long and very narrow* (Fig. 182). Apex of galea pointed, no apical lobe. Inner strip with long setae on surface. (14) *Maxillary palpus extraordinarily long, reaching to metasoma at rest, segments 3-6 greatly lengthened and flattened, segments 1 and 2 much shorter and rounded,* as in Fig. 182. (15) *Prementum very long and narrow, higher than wide apically* (Fig. 171), pl/W = .88, pw/pl = .05 (1 sp.). (16) Salivary plate well defined, no V-shaped brace. (17) Glossa rather short, gl/pl = .21, gl/W = .19 (1 sp.). (18) Segments 2 plus 3 of labial palpus shorter than 1.

MESOSOMA. (19) Pronotal lateral angle not produced, obtuse. Dorsal ridge carinate; lateral ridge rounded. (20) Mesoscutum not narrowed anteriorly, lip rounded. (22) Basal area of propodeum weakly striate basally, smooth apically. (24, 25) Marginal cell of forewing acute, rather long, mc/wl = .66 (1 sp.). (27) *Hind tibial spur with long serrations* (Fig. 219). (29) Basitibial plate of normal length, well defined on all edges, pointed. (30) Anterior basitarsal brush well-defined.

Male

HEAD. (35) Antenna reaching about to scutellum, no plate areas, flagellomere 1 longer than 2 but shorter than 10; sc/2 = 4.34, 2/1 = .82, 3/1 = 1.01, 10/1 = 1.31 (1 sp.). Clypeus with distal portion abruptly declivous, set off from apical portion by carina. (36) Labrum with basal elevation strongly protuberant, not extending across basal area, not notched; distal process not examined.

METASOMA. (38) Metasoma oval, not elongate. (39) Tergum VII strongly depressed beneath apodemes (Fig. 228), abruptly convex apically, no gradulus, long setae in single row near posterior margin. (40) Anal lip of proctiger with long post-anal filaments. (42) *Sternum IV unmodified,* with very short setae except laterally, dense medially. (43) Sternum V with postgradular area densely clothed with rather short setae, longer near posterior margin, posterior

margin slightly emarginate medially. (44) Sternum VI with setae as on V, posterior margin rather strongly notched medially. (45) Sternum VII not produced posteriorly, bearing setae, apodemes moderately recurved. Sternum VIII not produced posteriorly, without setae; laterally joining VII far from apices of apodemes. Spiculum moderately narrow (Fig. 324).

(46) Gonobase (Figs. 411-412) with narrow ventral bridge, rounded dorsal lobes strongly projecting over gonocoxites. (47) Ventral gonostylus an apically-projecting lobe bearing long setae on its ventral surface, setae longest apically. Basal process of gonostylus absent; parapenial lobe a narrow thin flap. Dorsal gonostylus a large membranous swollen process, surpassing ventral gonostylus, variously expanded in cleared specimens (inflatable?). (48) Penis valve with ventral prong and low longitudinal dorsal ridge merging anteriorly into slight dorsal depression. Valve expanded medially and laterally. (49) Volsella indented medially, inner apical angle projecting ventrally; transverse ridge below notch; base truncate.

Ariphanarthra contains only the type species *A. palpalis* Moure, a large (about 9 mm) bright bluish, rather shiny species. It is noteworthy for the extraordinary development of the maxillary palpi of both sexes, which trail beneath the bee and provide the best recognition character for the genus. The unusual shape of the head is also distinctive, as illustrated in Fig. 132. In most characters, *Ariphanarthra* resembles *Megaloptidia* and its relatives. The genus is known from southern Brazil and Paraguay.

Moure (1951) has provided a detailed description of the genus and type species.

Genus **Chlerogella** Michener

Chlerogella Michener, 1954, Bull. Amer. Mus. Natur. Hist. 104:75. (Type species: *Chlerogella elongaticeps* Michener, 1954, monobasic and original designation.)

Female

HEAD (Fig. 135). (1) *Epistomal sulcus forming acute angle, epistomal lobe protruding into clypeus.* (3) *Malar area greatly elongate, nearly twice as long as distance between mandibular articulations, head thereby very elongate.* (4) Preoccipital ridge rounded. (5) Hypostomal floor longer than wide, not measured. (8) Inner orbit of compound eye weakly emarginate, w/l = .088 (1 sp.). (11) Basal elevation of labrum low, elongate, rounded; basal area raised to either side of central elevation. Distal process not examined. (13-17) Mouthparts not dissected, not greatly narrowed or obviously modified, maxillary palpi rather long and slender.

MESOSOMA. (19) *Pronotum* (Fig. 198) *convex dorsally, lateral angle and lateral ridge completely absent, dorsal ridge rounded.* (20) *Mesoscutum joining pronotum almost at same level, mesoscutal lip almost absent.* (22) Basal area of propodeum longer than scutellum, smooth, no plicae. (24, 25) Mar-

ginal cell of forewing acute, very long, mc/wl = .70 (1 sp.). (27) Hind tibial spur pectinate, teeth long and pointed. (29) Basitibial plate defined on all edges, narrowly rounded. (30) Anterior basitarsal brush weakly defined.

Chlerogella is known only from the very unusual type species. *C. elongaticeps* Michener; this is a medium-sized (7.5 mm) lightly punctured mostly testaceous species with green tints. The highly elongate head and malar areas set *Chlerogella* apart from all other augochlorine genera except *Chlerogas,* whose species are larger and have more normal pronotal structure, and a bituberculate scutellum. Some species of *Caenohalictus,* a non-augochlorine genus, also have long heads with elongate malar areas; these species are easily distinguishable by the dense long hairs on their eyes and normal pronotal structure. The male of *Chlerogella* is unfortunately unknown. I have seen only the holotype specimen of *C. elongaticeps,* from Panama.

Michener (1954) presented additional generic and specific characters and illustrated the head of *C. elongaticeps.*

Genus **Temnosoma** Smith

Temnosoma Smith, 1853, Catalogue of hymenopterous insects in the collection of the British Museum 1:38. (Type species: *Temnosoma metallicum* Smith, 1853, monobasic.)

Micraugochlora Schrottky, 1909, Rev. Mus. La Plata 16:138. (Type species: *Micraugochlora sphaerocephala* Schrottky, 1909a, monobasic.) NEW SYNONYMY.

Temnosoma (Temnosomula) Ogloblin, 1953, Bol. Soc. Entomol. Argentina 2:2. (Type species: *Temnosoma (Temnosomula) platensis* Ogloblin, 1953, monobasic and original designation.) NEW SYNONYMY.

Female

HEAD (Fig. 138). (1) Epistomal sulcus forming obtuse angle. (2) Clypeus entirely green, coarsely punctate. (4) Preoccipital ridge sharply angled dorsally. Vertex produced above ocelli. (5, 6) Hypostoma about 1.5 times longer than wide, l/w = 1.50 to 1.58, c/l = .81 to .82 (2 spp.). (7) Posterior flange projects beyond occiput. (8) Inner orbit of compound eye moderately emarginate, w/l = .117 to .125 (2 spp.). (11) *Labrum* (Fig. 160) *with distal process expanded and truncate apically, distal process merging gradually into basal area, no distal keel.* Labral fimbria on anterior surface of distal process. Basal elevation notched medially; basal area swollen lateral to elevation. (12) *Mandible* (Fig. 168) *lacking subapical tooth, resembling mandible of male.* (13) Distal portion of maxilla rather short and broad, normal, inner strip with broad scale-like cuticular markings and without long setae, except apically. (14) Maxillary palpus, p/M = .28 to .36 (3 spp.). (15) *Prementum* (Fig. 172) *with anterior surface transparent, thin, premental thickenings defined only apically,* pl/W = .59 to .65, pw/pl = .17 to .18 (3 spp.). (16) Salivary plate (Fig. 174) normal, V-shaped brace. (17) Glossa short, gl/pl = .23 to .32, gl/W = .14 to .20 (3 spp.).

MESOSOMA. (19, 20) *Pronotum laterally not concave, mesoscutal lip almost absent.* Lateral angle (Fig. 197) rounded, not at all produced; lateral ridge

short and rounded. Dorsal ridge carinate. Ridge present on lateral surface of pronotum, running below lateral ridge from anterior surface to join anterior margin of pronotum below pronotal lobe. (21) Tegula (Fig. 200) entirely green, coarsely punctate. (22) Basal area of propodeum pitted basally, distally smooth with transverse striae. (23) Lateral carinae absent, posterior face coarsely punctate. (24, 25) Marginal cell of forewing acute, mc/wl = .63 to .65 (2 spp.). Second submarginal cell narrow or absent. (27) *Hind tibial spur* (Fig. 221) *serrate, similar to outer spur.* (28-30) *Scopa, mesofemoral brush, penicillus, basitibial plate, and anterior basitarsal brush all absent; legs resemble those of male.*

METASOMA. *Terga I-III very coarsely punctate, postgradular areas just posterior to gradulus strongly depressed, often with coarse transverse striae.* (31) *Pseudopygidial area of tergum V lacking, posterior marginal area as in male.* (32) Tergum VI (Fig. 229) narrow apically, pygidial plate narrowly rounded, suprapygidial plate poorly defined, gradulus absent. (34) Sterna IV and V resemble those of male (without basal post-gradular zone of long setae), not resembling normal female sterna. Sternum VI narrow apically, gradulus strong.

Male

HEAD. (35) Antenna short, pedicel and scape as in Fig. 180, no plate areas; sc/2 = 2.74 to 2.98, 2/1 = 1.64 to 1.78, 3/1 = 1.67 to 1.83, 10/1 = 1.64 to 1.95 (3 spp.). (36) *Labrum as in female* (Fig. 160), basal elevation extending across basal area.

METASOMA. (39) Tergum VII (Figs. 230-231) prolonged apically, gradually convex, apical margin bilobed, gradulus absent. (40) Anal lip of proctiger (Fig. 232) without post-anal filaments. (42-44) Sterna IV to VI (Figs. 260-261) with apodemes small, zone of dense long simple setae at base of post-gradular areas of sterna V and VI. Sternum VI weakly notched, postgradular area without setae centrally, shiny. (45) *Sternum VII with only apodemes sclerotized, centrally represented by seta-bearing membrane.* Posterior margin of sternum VIII more or less produced medially, usually bearing setae; laterally joining VII at apices of apodemes. Spiculum narrow (Fig. 318).

(46) Gonobase (Figs. 413-416) rather small, with rather wide ventral bridge and small dorsal lobes. (47) Ventral gonostylus a very large lobe, bearing setae on its ventral surface, with very long setae on its dorsal margins. Small membranous parapenial lobe present basal to or beneath ventral gonostylus; basal process of gonostylus absent. Dorsal gonostylus a simple seta-bearing ridge behind ventral gonostylus. (48) *Penis valve* (Fig. 416) *with greatly prolonged dorsal prong arising basal to dorsal depression and extending apically to surpass dorsal crest;* ventral prong absent. (49) Volsella (Fig. 415) very small, rounded or tapered basally.

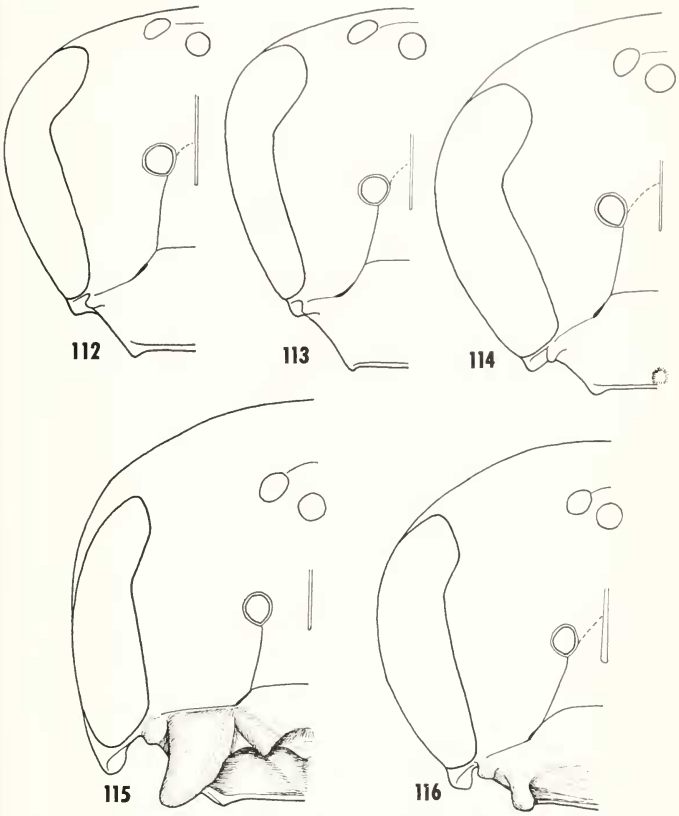
Species of *Temnosoma* are among the most distinctive halictine bees, resembling chrysidid wasps more than bees in general appearance. The small (less than ten species) closely knit genus is characterized by extremely coarse punctation, bright green or blue coloration and lack of all pollen-collecting apparatus in the female. Males and females resemble each other so closely that separation of sexes is difficult without a microscope; the last externally visible metasomal terga and sterna offer the best sexual characters. Species range in size from small to medium, and are found from Arizona to Argentina.

Smith's (1853) original description of *Temnosoma* gave no inkling of the unusual characteristics of this genus, as he stressed the mouthparts and wing venation, but his description of the type species pointed out the punctation and metasomal characters. *Temnosoma* has been correctly recognized by all authors to date. Due to the lack of scopa, most early authors considered it closely related to *Sphecodes,* and Ducke (1912) placed *Temnosoma* as a subgenus of *Sphecodes.* In actuality, *Sphecodes* and *Temnosoma* are not closely related, their concurrent characters being apparently convergent, due to a presumed social parasitic existence. Friese (1924) revised *Temnosoma,* recognizing six species.

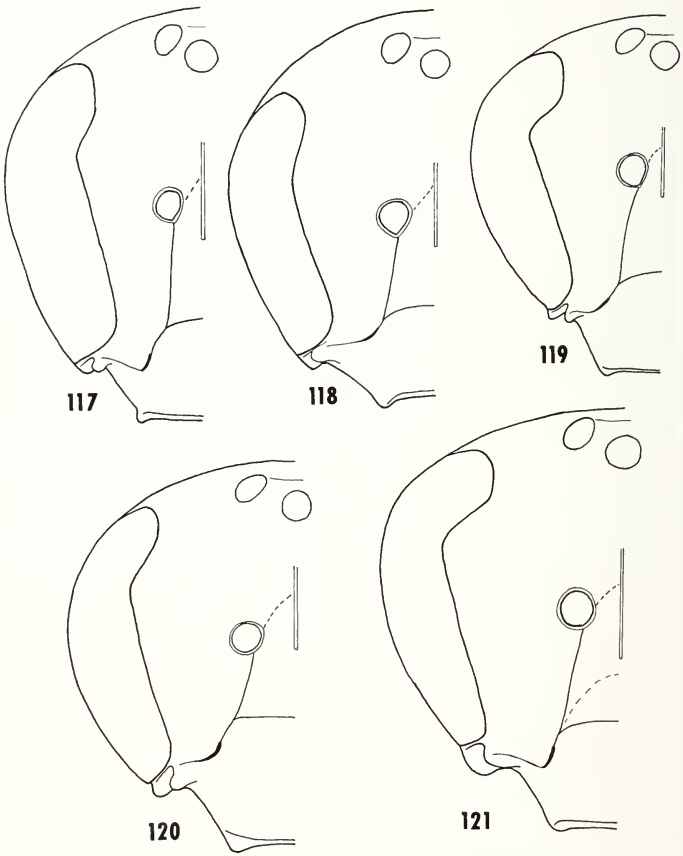
Schrottky (1909a) erected *Micraugochlora* for a small coarsely punctate green bee with simple tibial spurs. He placed *Micraugochlora* in the Panurgidae due to its two submarginal cells and compared it with *Gastrohalictus* (= *Dialictus,* a subgenus of *Lasioglossum*). His description gave little hint of its similarity to *Temnosoma.*

Ogloblin (1953, 1954) described the subgenus *Temnosomula* for a new species with two submarginal cells. Ogloblin (1954) accurately described and illustrated the hidden male sterna and genitalia of his species. Moure has examined the types of both *Temnosomula* and *Micraugochlora* and determined that *Micraugochlora sphaerocephala* Schrottky, 1909a, is a senior synonym of *Temnosoma platensis* Ogloblin, 1953, and the synonymy should be credited to him. Through Padre Moure's courtesy, I have been able to examine a paratype of *Temnosoma platensis.* I consider this species to be not subgenerically distinct; the differences in the hidden sterna that Ogloblin described are minor.

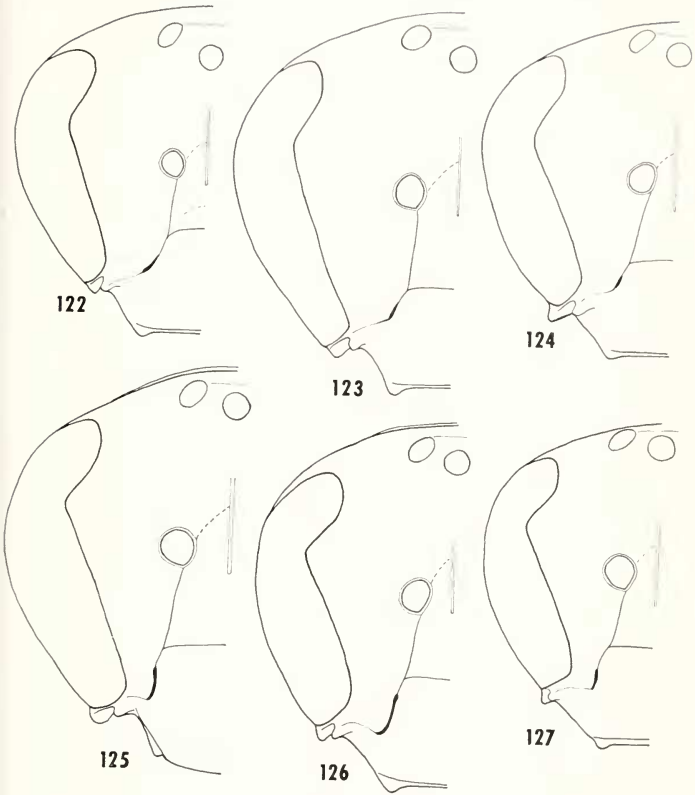
The best known species of *Temnosoma* are *T. smaragdinum* Smith from the Southwestern United States (Timberlake, 1958), Mexico, and Central America, and *T. metallicum* Smith from South America.



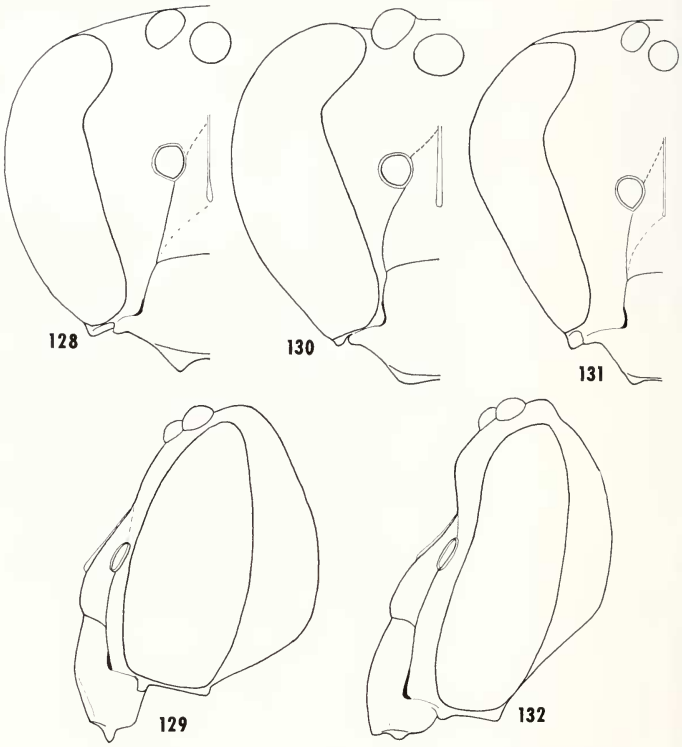
Figs. 112-116. Heads of female Augochlorini. 112, *Corynura* (*Corynura*) *chilensis* (Spinola); 113, *Halictillus* sp.; 114, *Rhinocorynura briseis* (Smith); 115, *Rhinocorynura inflaticeps* (Ducke); 116, *Rhinocorynura* sp.



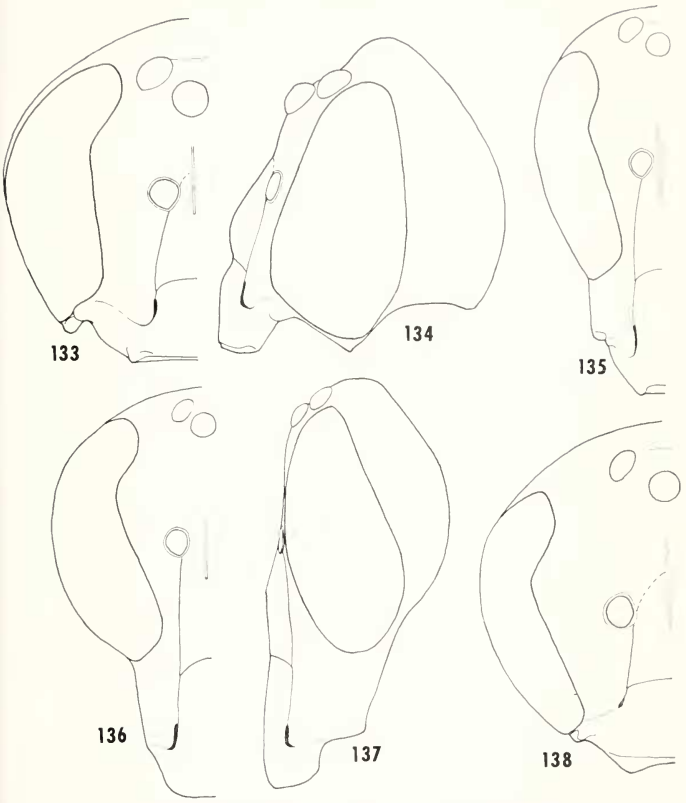
FIGS. 117-121. Heads of female Augochlorini. **117,** *Corynurella mourei* n. sp.; **118,** *Rhectomia pumilla* Moure; **119,** *Neocorynura (Neocorynura) pubescens* (Friese); **120,** *Paroxystoglossa transversa* Moure; **121,** *Andinaugochlora micheneri* n. sp.



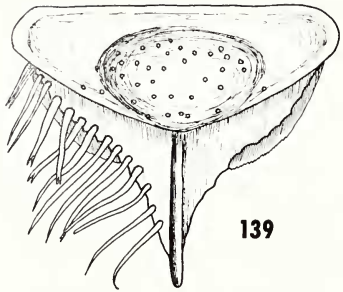
Figs. **122-127.** Heads of female Augochlorini. **122,** *Augochloropsis (Paraugochloropsis) metallica* (Fabricius); **123,** *Thectochlora alaris* (Vachal); **124,** *Ceratalictus theia* (Schrottky); **125,** *Augochlora (Mycterochlora) repandirostris* (Vachal); **126,** *Augochlora (Augochlora) pura* (Say); **127,** *Augochlorella striata* (Provancher).

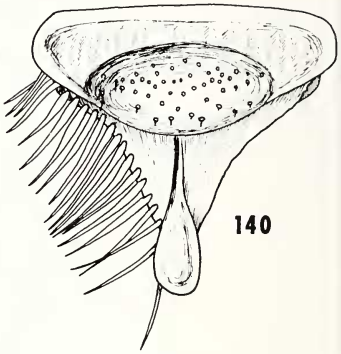


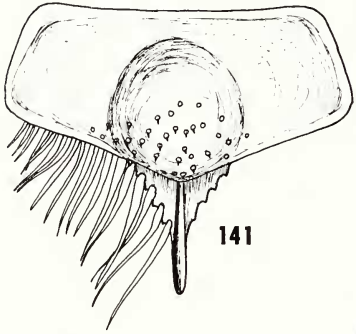
FIGS. **128-132.** Heads of female Augochlorini. **128,** *Megommation (Megommation) insigne* (Smith); **129,** *Megommation (Megaloptina)* sp.; **130,** *Megaloptidia ?contradicta* (Cockerell); **131-132,** *Ariphanarthra palpalis* Moure.

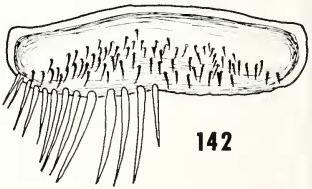


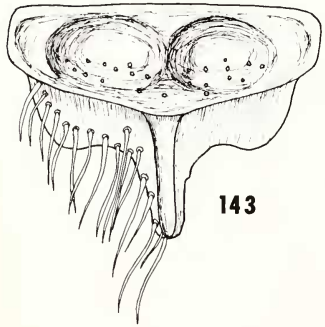
Figs. 133-138. Heads of Augochlorini. 133-135, 138, females; 136-137, male. 133-134, *Megalopta genalis* Meade-Waldo; 135, *Chlerogella elongaticeps* Michener; 136-137, *Chlerogas hirsutipennis* Cockerell; 138, *Temnosoma smaragdinum* Smith.

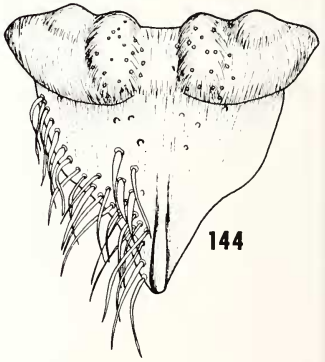




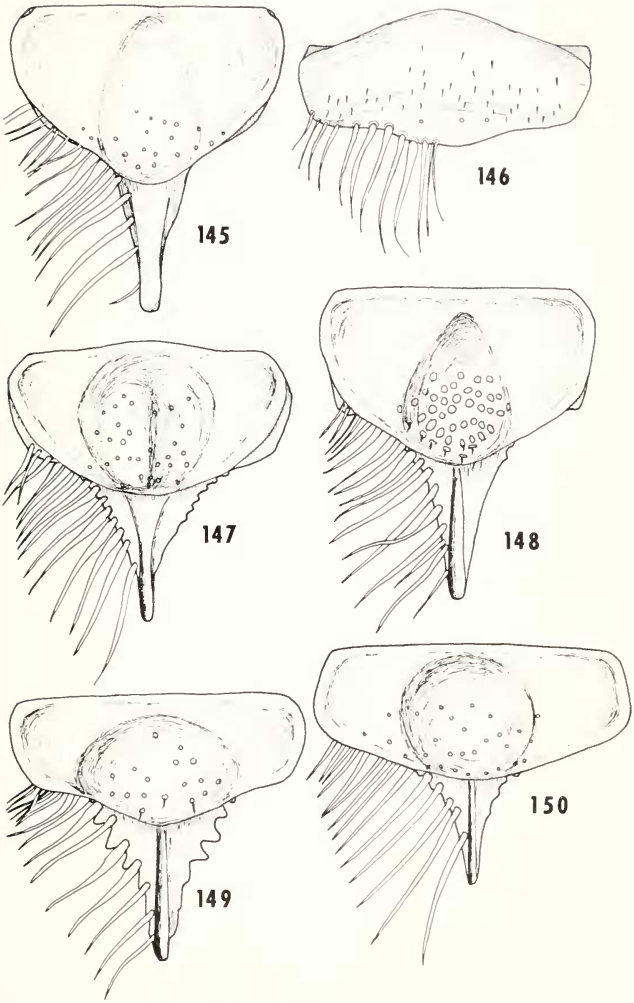




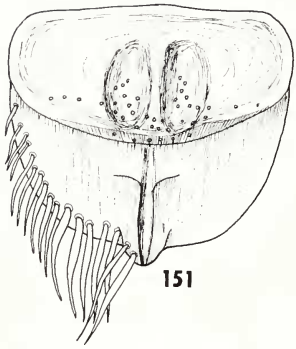


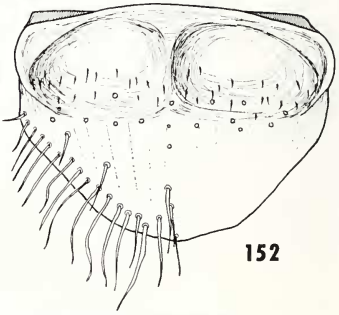


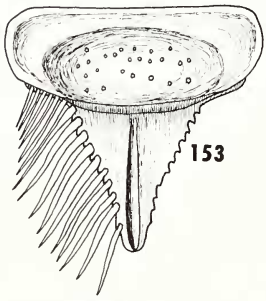
FIGS. **139-144.** Labra of Augochlorini. **139-141, 143-144,** females; **142,** male. **139,** *Corynura (Corynura) chilensis* (Spinola); **140,** *Corynura (Callochlora) chloris* (Spinola); **141,** *Halictillus* sp.; **142,** *Corynura (Corynura) chilensis* (Spinola); **143,** *Rhinocorynura briseis* (Smith); **144,** *Rhinocorynura* sp.

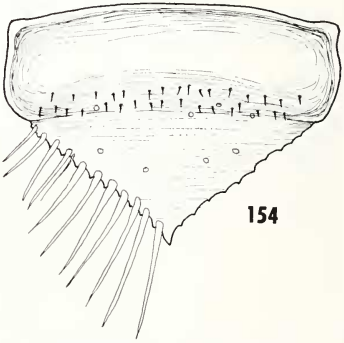


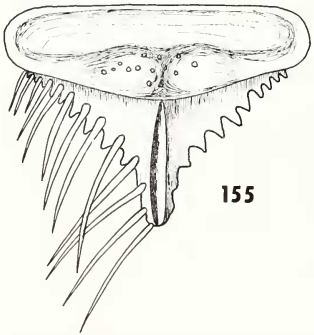
Figs. 145-150. Labra of Augochlorini. 145, 147-150, females; 146, male. 145-146, *Neocorynura (Neocorynura) pubescens* (Friese); 147, *Paroxystoglossa transversa* Moure; 148, *Andinaugochlora micheneri* n. sp.; 149, *Thectochlora alaris* (Vachal); 150, *Augochlorodes turrifaciens* Moure.

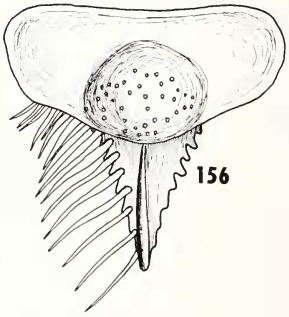




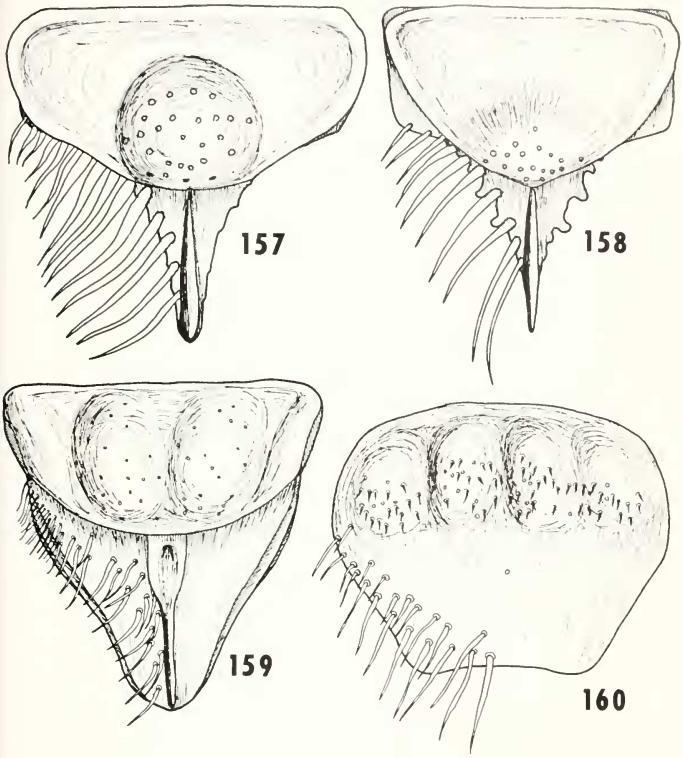




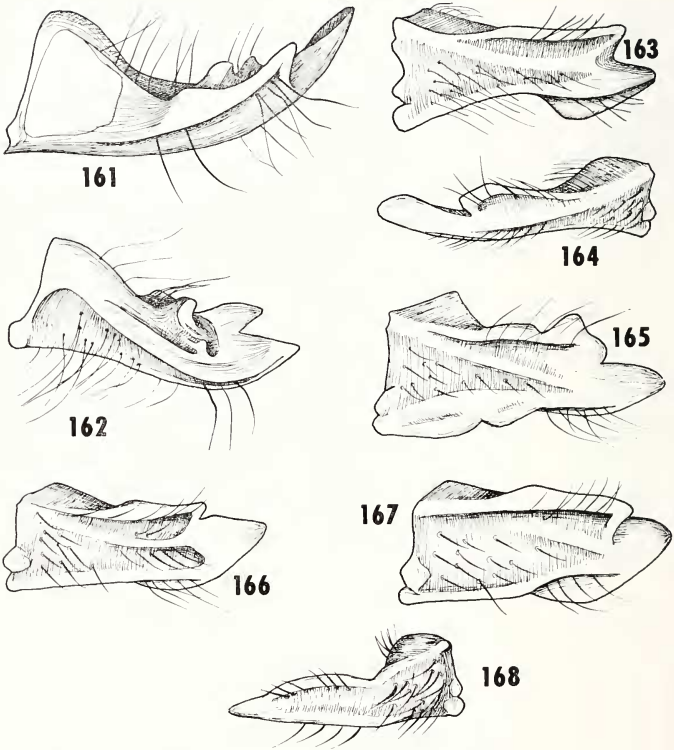




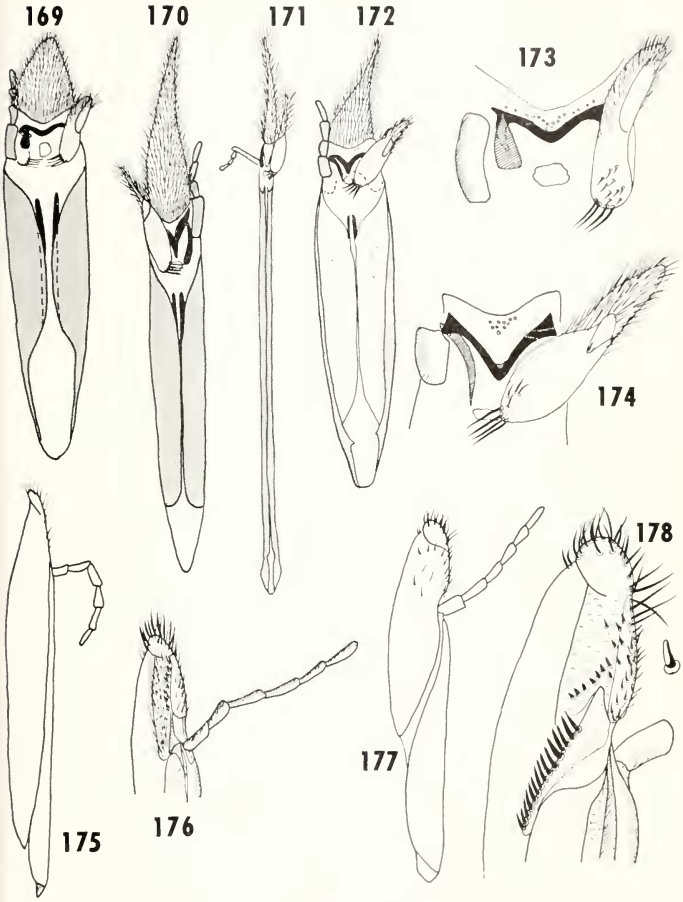
FIGS. **151-156.** Labra of Augochlorini. **151-152,** *Augochloropsis (Paraugochloropsis) metallica* (Fabricius) (151, female; 152, male); **153-154,** *Augochlora (Augochlora) pura* (Say) (153, female; 154, male); **155,** *Augochlora (Mycterochlora) repandirostris* (Vachal) female; **156,** *Augochlora (Oxystoglossella) antonita* Michener female.



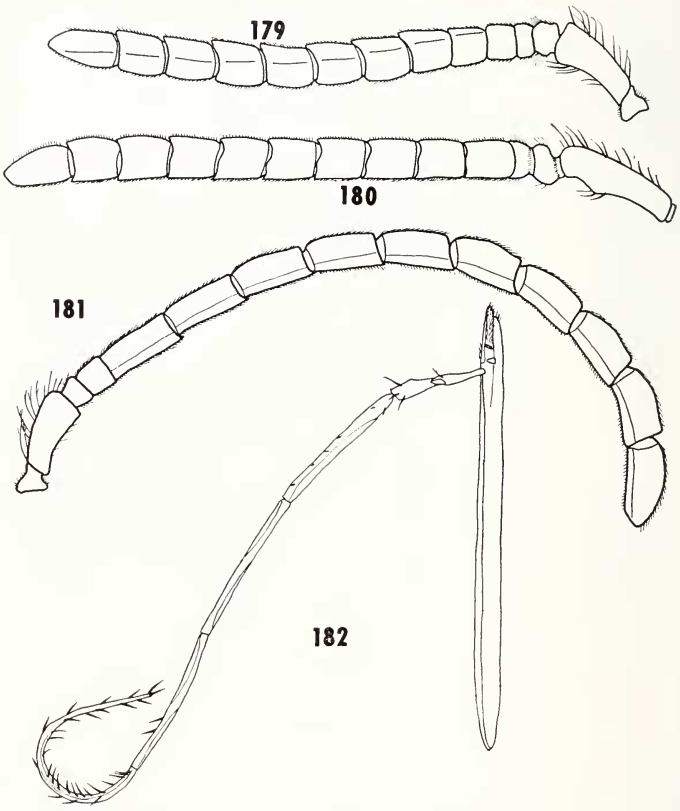
Figs. **157-160.** Labra of female Augochlorini. **157,** *Augochlorella striata* (Provancher); **158,** *Pereirapis* sp.; **159,** *Megalopta genalis* Meade-Waldo; **160,** *Temnosoma smaragdinum* Smith.



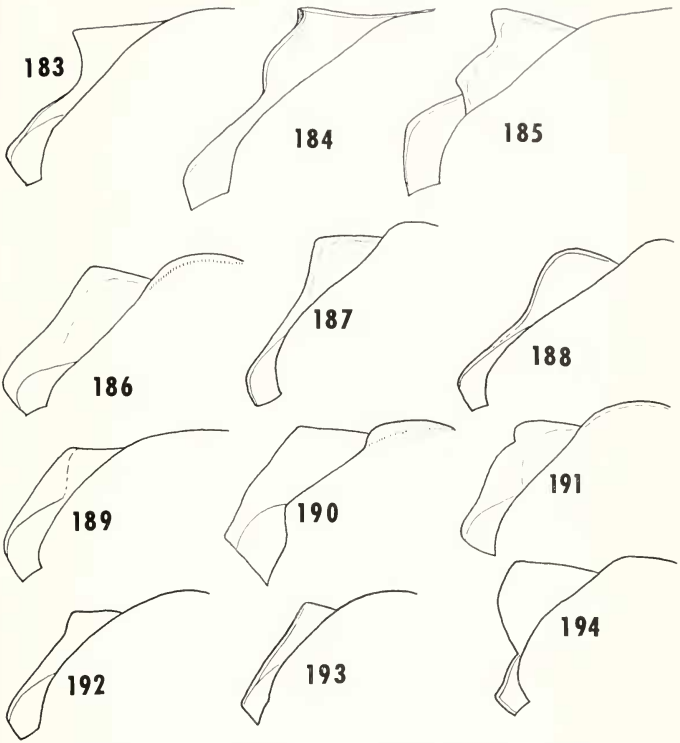
FIGS. **161-168.** Mandibles of female Augochlorini. **161-162,** *Megalopta genalis* Meade-Waldo (161, anterior view; 162, inner view);**163-168,** outer views. **163,** *Augochlora (Augochlora) pura* (Say); **164,** *Augochlora (Oxystoglossella)* sp.; **165,** *Rhinocorynura* sp.; **166,** *Megommation (Megommation) insigne* (Smith); **167,** *Ariphanarthra palpalis* Moure; **168,** *Temnosoma smaragdinum* Smith.



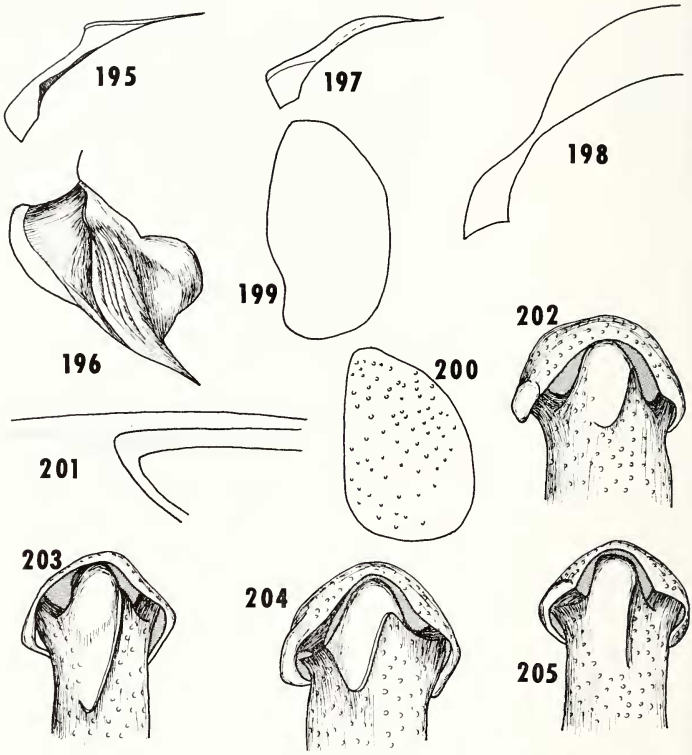
Figs. **169-178.** Mouthparts of Augochlorini. **169-172,** distal portions of labia, anterior views. **169,** *Corynura (Corynura) chilensis* (Spinola); **170,** *Augochlora (Augochlora) pura* (Say); **171,** *Ariphanarthra palpalis* Moure; **172,** *Temnosoma smaragdinum* Smith. **173-174,** bases of ligulae, anterior views. **173,** *Corynura (Corynura) chilensis* (Spinola); **174,** *Temnosoma smaragdinum* Smith. **175-178,** distal portions of maxillae. **175-176,** *Augochlora (Augochlora) pura* (Say) (175, posterior view; 176, post-palpal portion, anterior view); **177-178,** *Corynura (Corynura) chilensis* (Spinola) (177, posterior view, 178, post-palpal portion, anterior view).



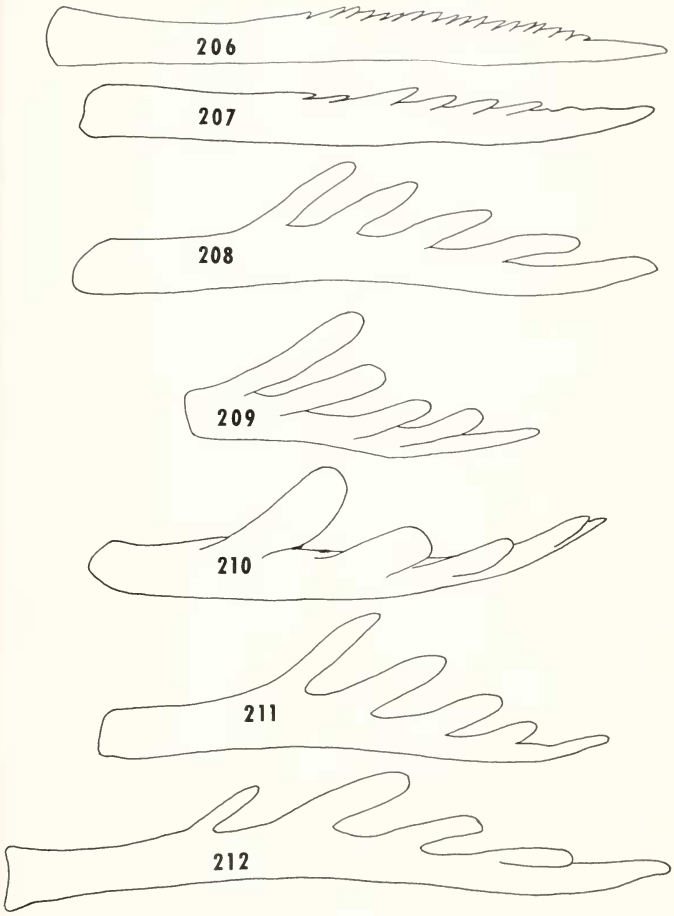
FIGS. **179-182.** Head appendages of Augochlorini. **179-181,** antennae of males. **179,** *Augochlora (Augochlora) pura* (Say); **180,** *Temnosoma smaragdinum* Smith; **181,** *Corynura (Corynura) chilensis* (Spinola). **182,** distal portion of maxilla of *Ariphanarthra palpalis* Moure, anterior view.



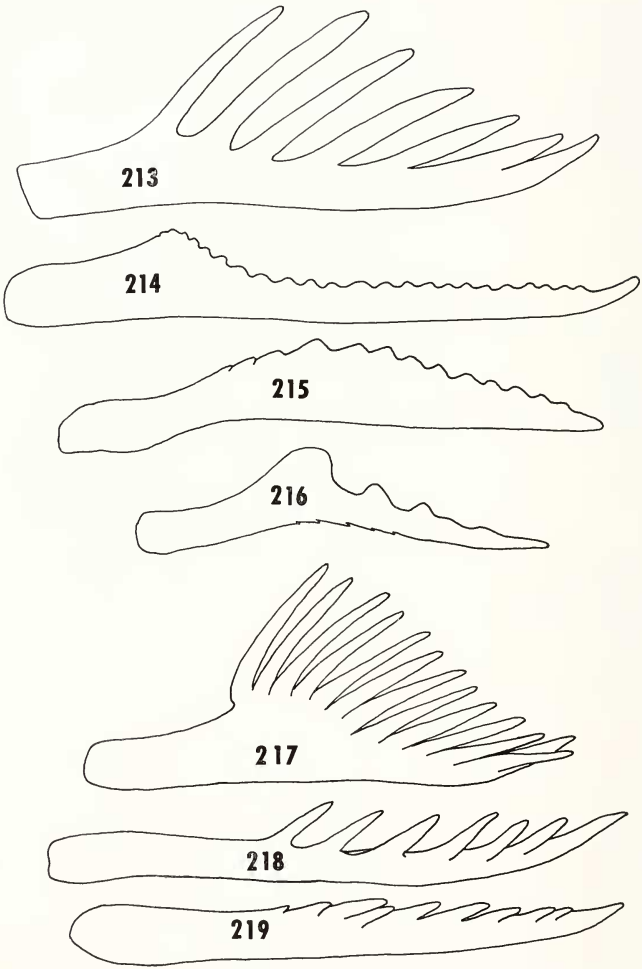
Figs. 183-194. Pronota and mesoscutal lips of female Augochlorini, dorsal views. **183,** *Corynura (Corynura) chilensis* (Spinola); **184,** *Corynurella mourei* n. sp.; **185,** *Rhectomia pumilla* Moure; **186,** *Rhinocorynura briseis* (Smith); **187,** *Neocorynura (Neocorynura) pubescens* (Friese); **188,** *Paroxystoglossa transversa* Moure; **189,** *Augochloropsis (Paraugochloropsis) metallica* (Fabricius); **190,** *Augochloropsis* sp. *(=Glyptochlora);* **191,** *Thectochlora alaris* (Vachal); **192,** *Augochlora (Augochlora)* sp.; **193,** *Augochlora (Mycterochlora) repandirostris* (Vachal); **194,** *Augochlora (Oxystoglossella)* sp.



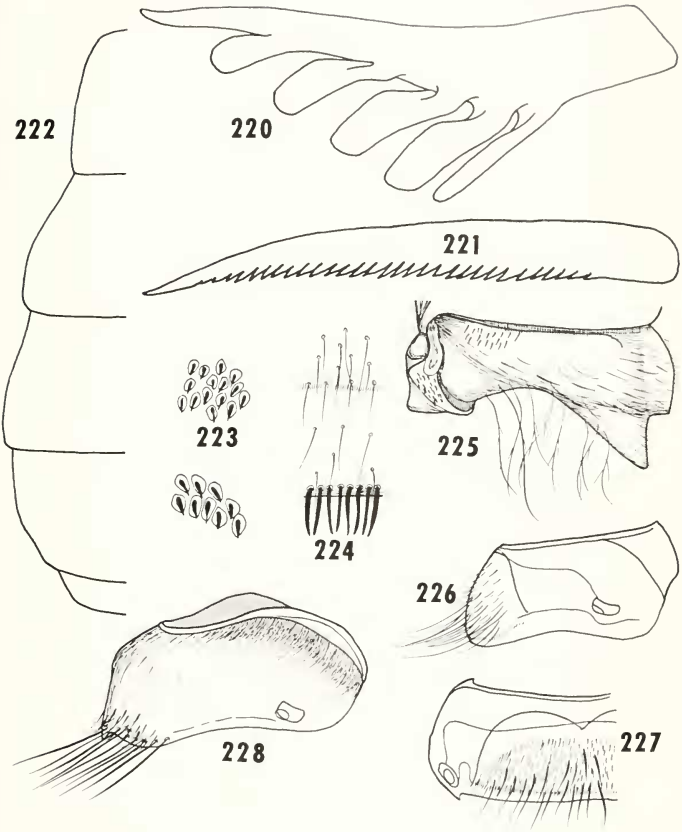
FIGS. **195-205.** Mesosomal structures of female Augochlorini. **195-198,** pronota and mesoscutal lips. **195-196,** *Megalopta genalis* Meade-Waldo (195, dorsal view; 196, lateral view); **197,** *Temnosoma smaragdinum* Smith, dorsal view; **198,** *Chlerogella elongaticeps* Michener, dorsal view. **199-200,** tegulae. **199,** *Augochloropsis (Paraugochloropsis) metallica* (Fabricius); **200,** *Temnosoma smaragdinum* Smith. **201,** apex of marginal cell of forewing of *Augochlorella striata* (Provancher). **202-205,** basitibial plates, anterior edges to left. **202,** *Corynura (Callochlora) chloris* (Spinola); **203,** *Andinaugochlora micheneri* n. sp.; **204,** *Augochloropsis (Paraugochloropsis) metallica* (Fabricius); **205,** *Megalopta genalis* Meade-Waldo.



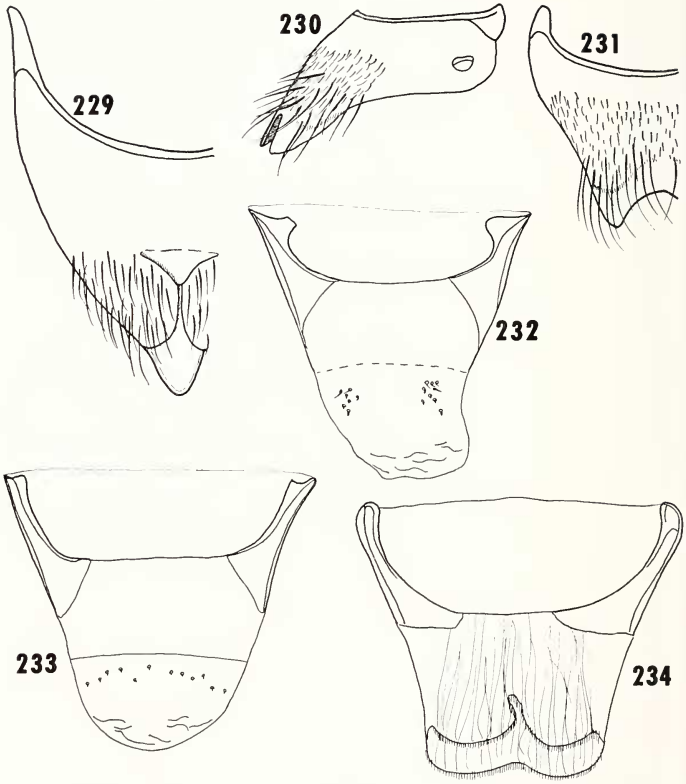
Figs. 206-212. Inner hind tibial spurs of female Augochlorini. 206, *Corynura (Corynura) chilensis* (Spinola); 207, *Corynura (Corynura) corynogaster* (Spinola); 208, *Corynura (Callochlora) chloris* (Spinola); 209, *Halictillus* sp.; 210, *Rhinocorynura* sp.; 211, *Neocorynura (Neocorynura) pubescens* (Friese); 212, *Andinaugochlora michencri* n. sp.



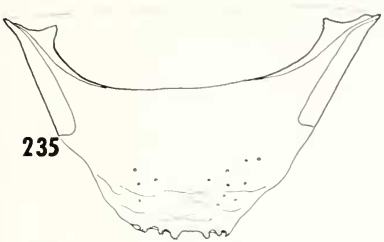
FIGS. **213-219.** Inner hind tibial spurs of female Augochlorini. **213,** *Augochloropsis (Augochloropsis) ignita* (Smith); **214,** *Augochlora (Augochlora) nigrocyanea* (Cockerell); **215,** *Ceratalictus theia* (Schrottky); **216,** *Pereirapis* sp.; **217,** *Caenaugochlora (Ctenaugochlora) perpectinata* (Michener); **218,** *Megommation (Megaloptina)* sp.; **219,** *Ariphanarthra palpalis* Moure.

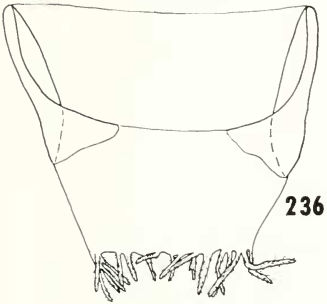


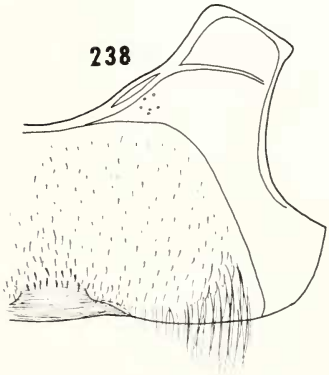
Figs. 220-228. Mesosomal and metasomal structures of Augochlorini. 220-221, inner hind tibial spurs of females. 220, *Megalopta genalis* Meade-Waldo; 221, *Temnosoma smaragdinum* Smith. 222, metasoma of *Neocorynura (Neocorynura) pubescens* (Friese) male, dorsal view. 223, scale-like setae of pseudopygidial area of *Augochlora (Augochlora) pura* (Say) female. 224, Apical setae (vibrissae) of metasomal tergum I of *Augochloropsis (Paraugochloropsis) metallica* (Fabricius) female. 225, Metasomal sternum I of *Augochlora (Augochlora)* sp., lateral view. 226-228, Metasomal terga VII of males. 226, *Augochloropsis (Paraugochloropsis) metallica* (Fabricius), lateral view; 227, *Augochloropsis (Augochloropsis) ignita* (Smith), posterior view; 228, *Ariphanarthra palpalis* Moure, posterior-lateral view.

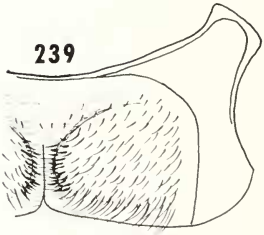


FIGS. **229-234.** Metasomal terga of Augochlorini. **229,** tergum VI of *Temnosoma smaragdinum* Smith female, dorsal view; **230-231,** tergum VII of *Temnosoma smaragdinum* Smith male (230, lateral view; 231, dorsal view). **232-234,** proctigers of males. **232,** *Temnosoma smaragdinum* Smith; **233,** *Ceratalictus theia* (Schrottky); **234,** *Rhinocorynura briseis* (Smith).

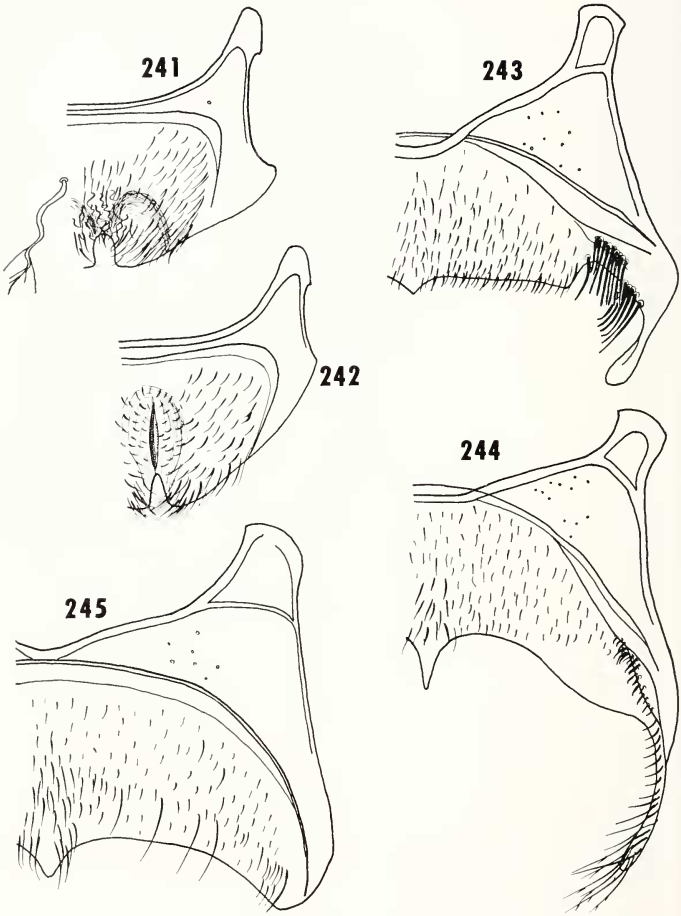




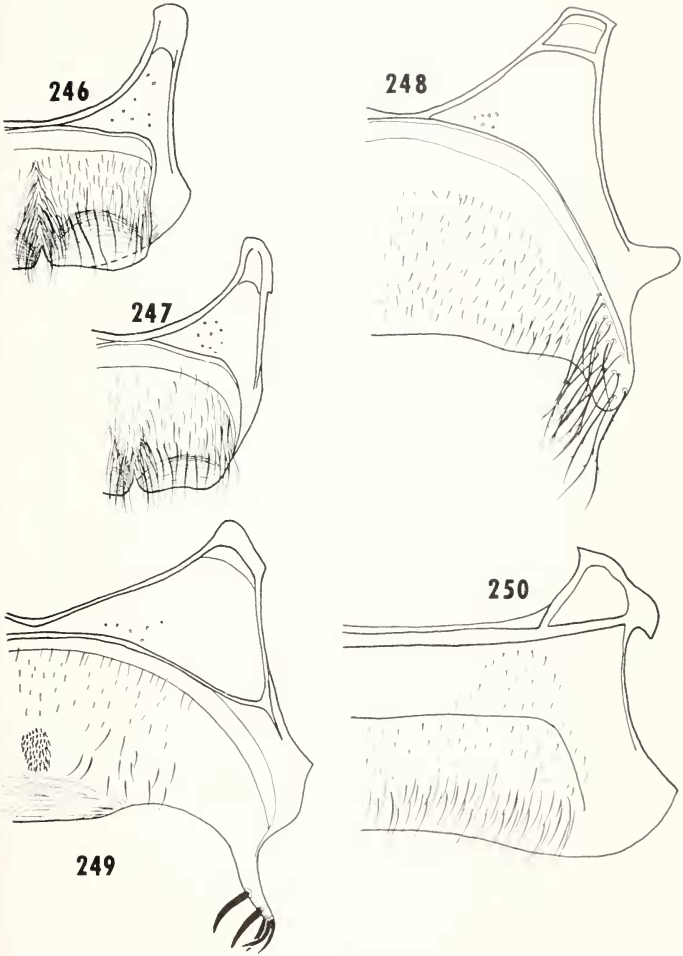




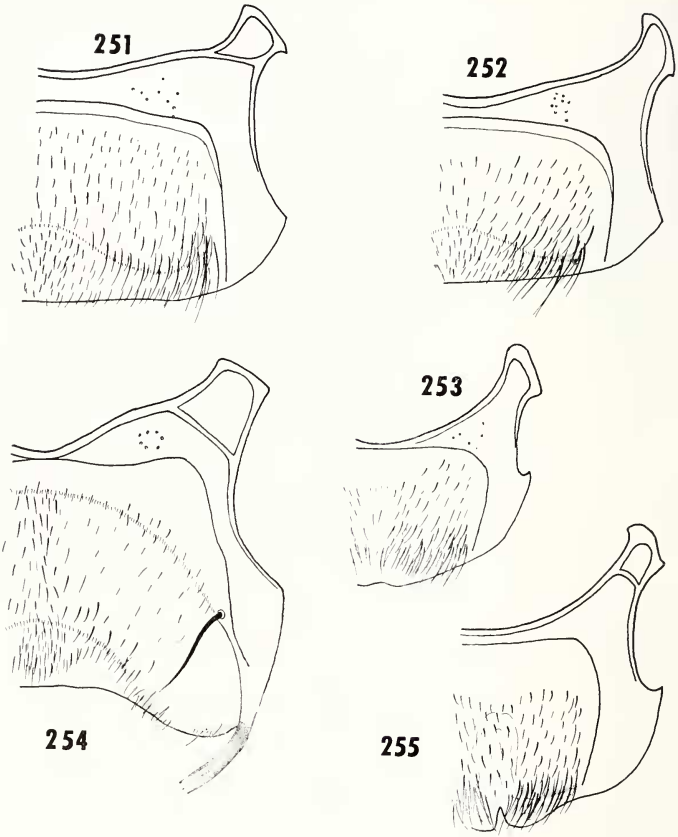
Figs. **235-240.** Metasomal structures of male Augochlorini. **235-236,** proctigers. **235,** *Augochloropsis (Paraugochloropsis) erato* (Holmberg); **236,** *Augochlora (Augochlora) pura* (Say). **237,** sternum II of *Neocorynura (Neocorynura) discolor knabiana* Cockerell. **238-240,** sterna of *Paroxystoglossa transversa* Moure (238, sternum IV; 239, sternum V; 240, sternum VI).



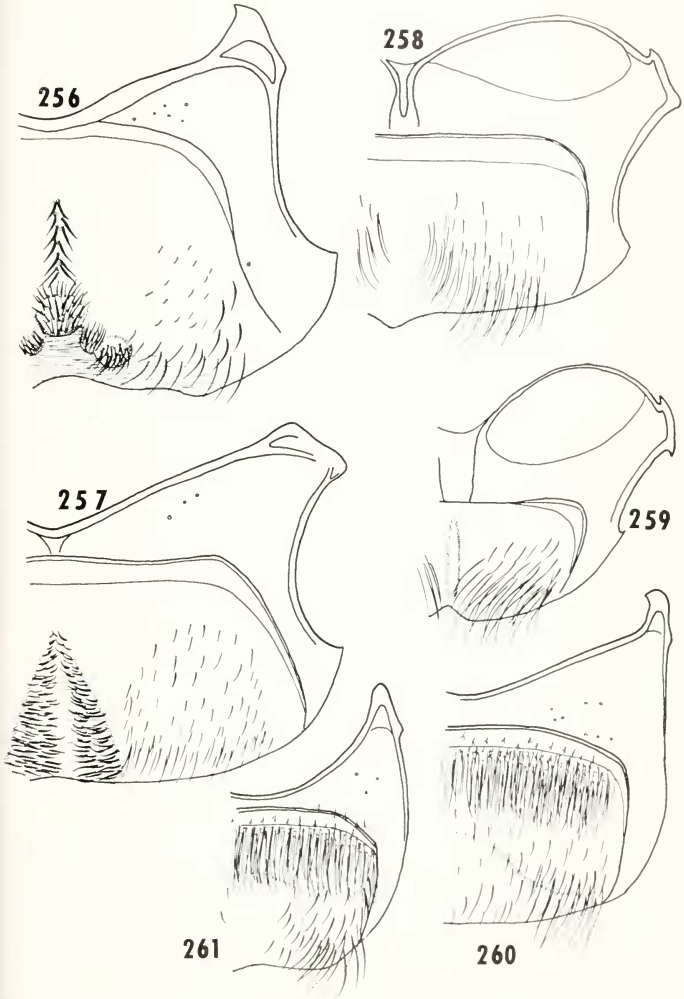
FIGS. 241-245. Metasomal sterna of male Augochlorini. **241,** sternum VI of *Andinaugochlora micheneri* n. sp.; **242,** sternum VI of *Chlerogas ?chlerogas* (Vachal); **243,** sternum IV of *Augochloropsis (Augochloropsis) ignita* (Smith); **244,** sternum IV of *Augochloropsis (Paraugochloropsis) metallica* (Fabricius); **245,** sternum IV of *Augochloropsis (Paraugochloropsis) chloera* (Moure) (=*Glyptobasia*).



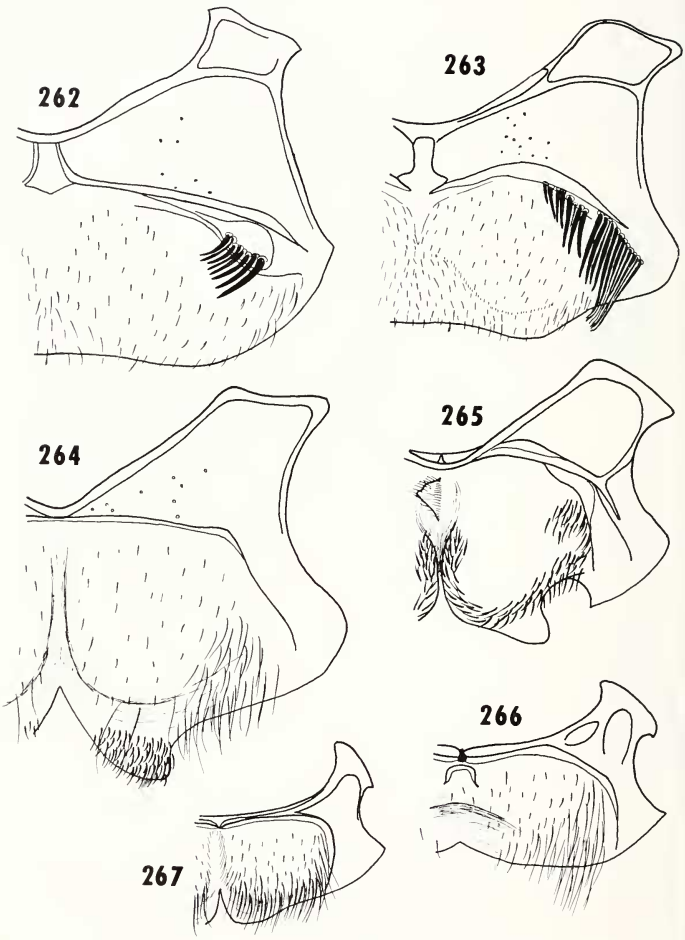
Figs. **246-250.** Metasomal sterna of Augochlorini. **246,** sternum VI of *Augochloropsis (Augochloropsis) ignita* (Smith) male; **247,** sternum VI of *Augochloropsis (Paraugochloropsis) metallica* (Fabricius) male; **248,** sternum IV of *Augochlorodes turrifaciens* Moure male; **249,** sternum IV of *Thectochlora alaris* (Vachal) male; **250,** sternum IV of *Augochlora (Augochlora) pura* (Say) female.



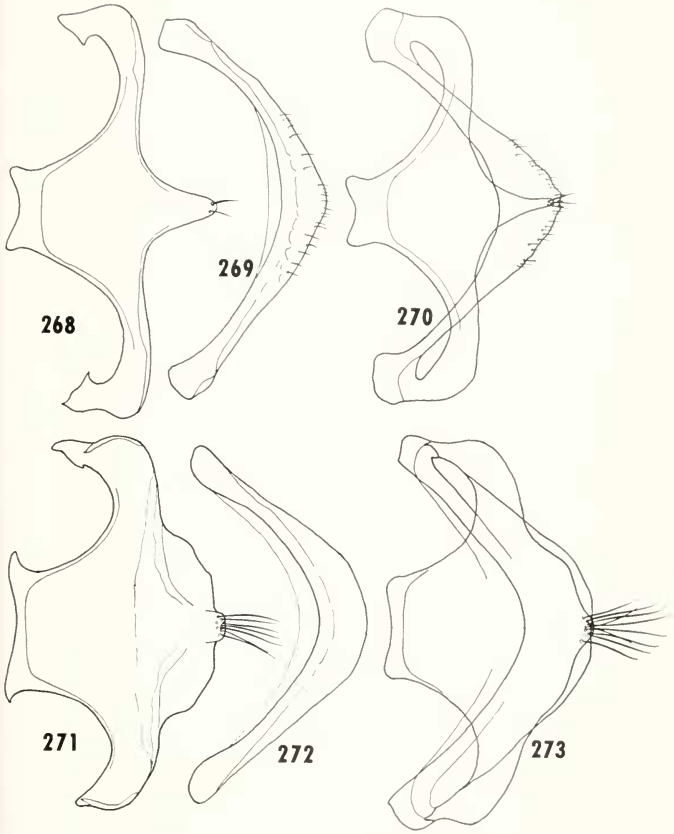
FIGS. **251-255.** Metasomal sterna of male Augochlorini. **251-253,** *Augochlora (Augochlora) pura* (Say) (251, sternum IV; 252, sternum V; 253, sternum VI); **254-255,** *Pereirapis* sp. (254, sternum IV; 255, sternum VI).



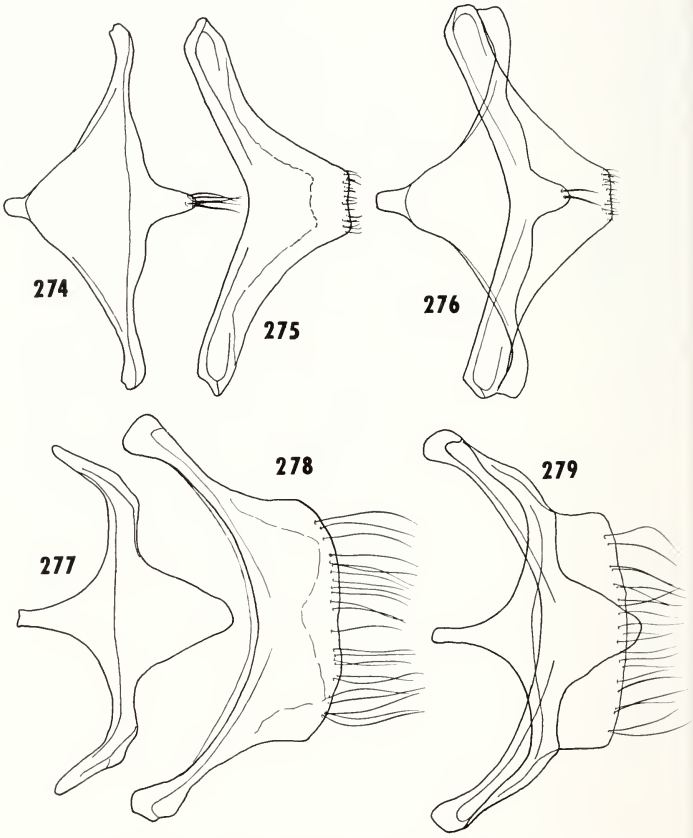
Figs. 256-261. Metasomal sterna of male Augochlorini. 256, sternum IV of *Caenaugochlora (Caenaugochlora) costaricensis* (Friese); 257-259, *Caenaugochlora (Ctenaugochlora) perpectinata* (Michener) (257, sternum IV; 258, sternum V; 259, sternum VI); 260-261, *Temnosoma smaragdinum* Smith (260, sternumV; 261, sternum VI).



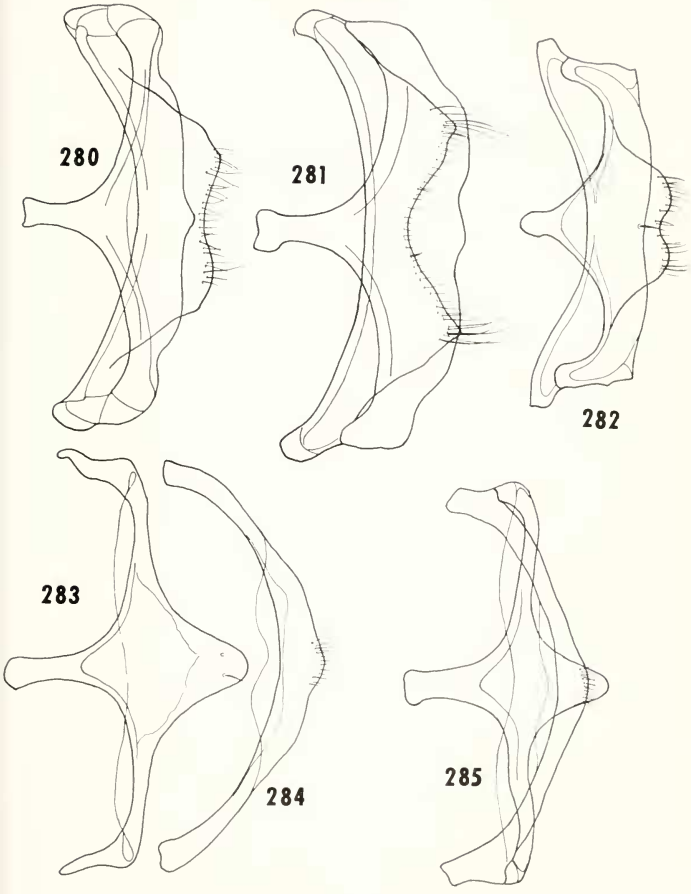
FIGS. **262-267.** Metasomal sterna of male Augochlorini. **262,** sternum IV of *Megommation (Megaloptina)* sp.: **263,** sternum IV of *Megommation (Megommation) insigne* (Smith); **264-267,** *Megalopta genalis* Meade-Waldo (264, sternum III; 265, sternum IV; 266, sternum V; 267, sternum VI).



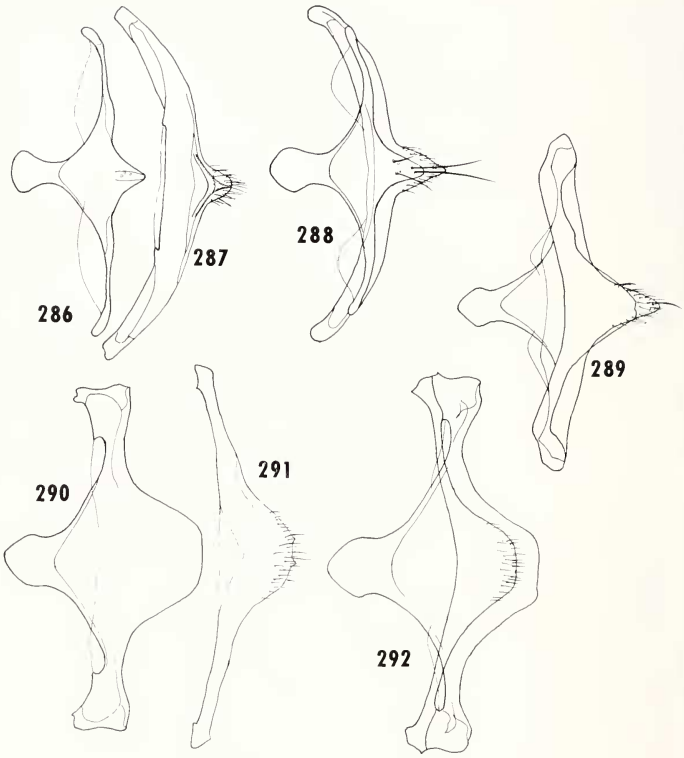
Figs. **268-273.** Metasomal sterna of male Augochlorini, anterior edges to left. **268-270,** *Corynura (Corynura) chilensis* (Spinola) (268, sternum VIII; 269, sternum VII; 270, sterna VII and VIII fused); **271-273,** *Corynura (Callochlora) chloris* (Spinola) (271, sternum VIII; 272, sternum VII; 273, sterna VII and VIII fused).



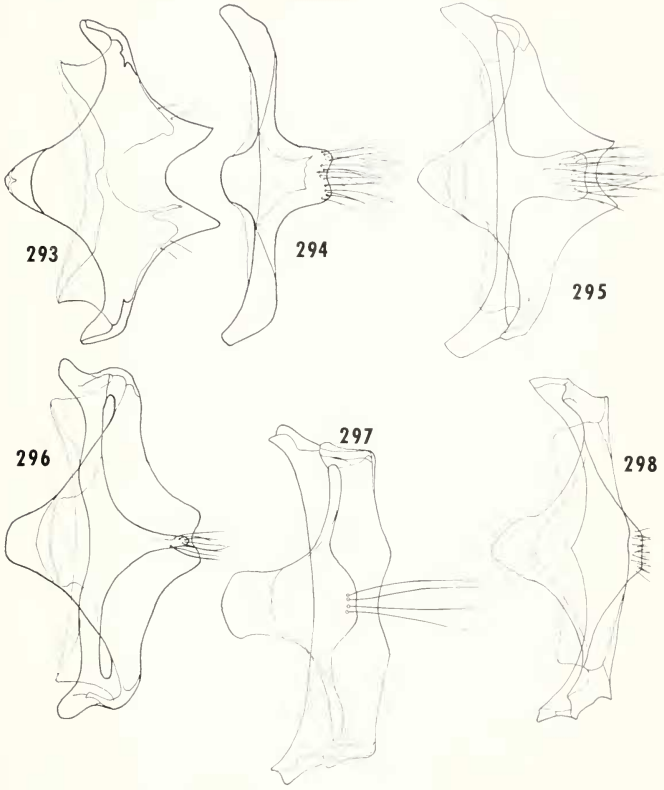
FIGS. **274-279.** Metasomal sterna of male Augochlorini, anterior edges to left. **274-276,** *Halictillus* sp. (274, sternum VIII; 275, sternum VII; 276, sterna VII and VIII fused); **277-279,** *Rhinocorynura briseis* (Smith) (277, sternum VIII; 278, sternum VII; 279, sterna VII and VIII fused).



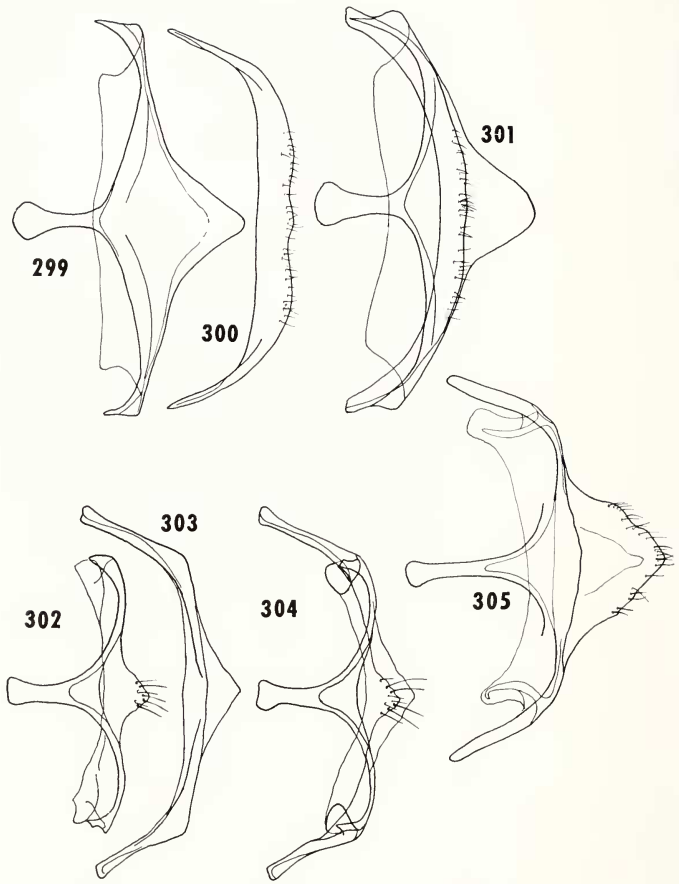
Figs. 280-285. Metasomal sterna of male Augochlorini, anterior edges to left. 280, sterna VII and VIII fused of *Rhinocorynura inflaticeps* (Ducke); 281, sterna VII and VIII fused of *Rhinocorynura* sp.; 282, sterna VII and VIII fused of *Corynurella mourei* n. sp.; 283-285, *Neocorynura (Neocorynura) pubescens* (Friese) (283, sternum VIII; 284, sternum VII; 285, sterna VII and VIII fused).



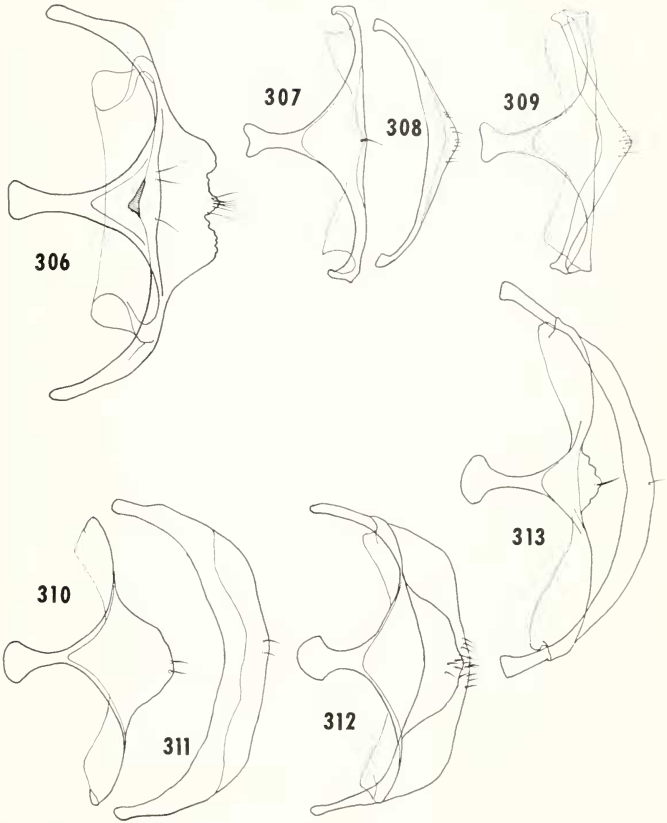
FIGS. 286-292. Metasomal sterna of male Augochlorini, anterior edges to left. **286-288,** *Paroxystoglossa transversa* Moure (286, sternum VIII; 287, sternum VII; 288, sterna VII and VIII fused); **289,** sterna VII and VIII fused of *Chlerogas ?chlerogas* (Vachal); **290-292,** *Andinaugochlora micheneri* n. sp. (290, sternum VIII; 291, sternum VII; 292, sterna VII and VIII fused).



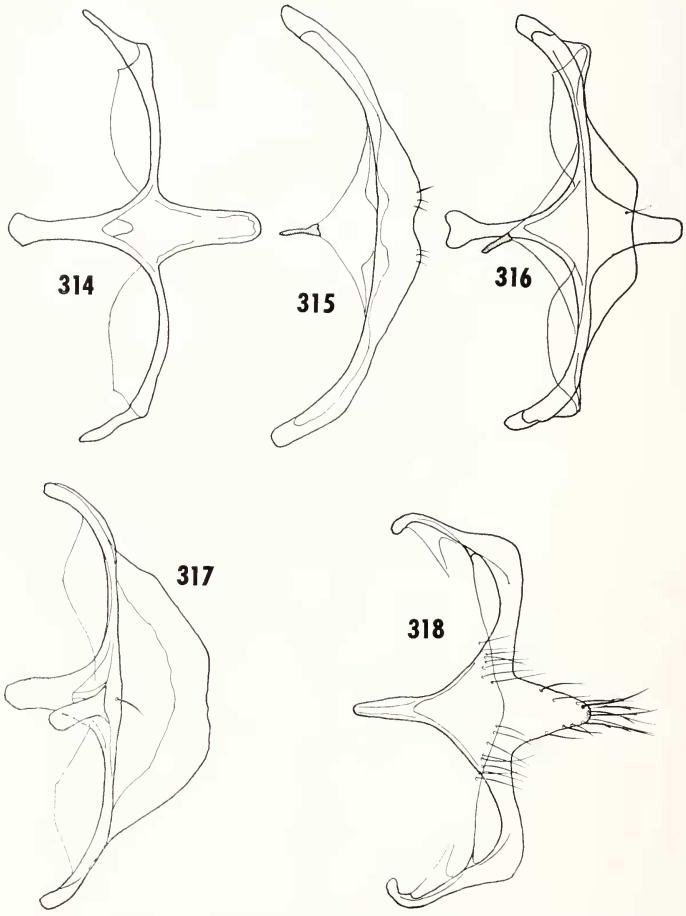
Figs. 293-298. Metasomal sterna of male Augochlorini, anterior edges to left. 293-295, *Augochloropsis (Paraugochloropsis) metallica* (Fabricius) (293, sternum VIII; 294, sternum VII; 295, sterna VII and VIII fused); 296, sterna VII and VIII fused of *Augochloropsis (Augochloropsis) ignita* (Smith); 297, sterna VII and VIII fused of *Augochloropsis (Paraugochloropsis) chloera* (Moure) (=*Glyptobasia*); 298, sterna VII and VIII fused of *Augochlorodes turrifaciens* Moure.



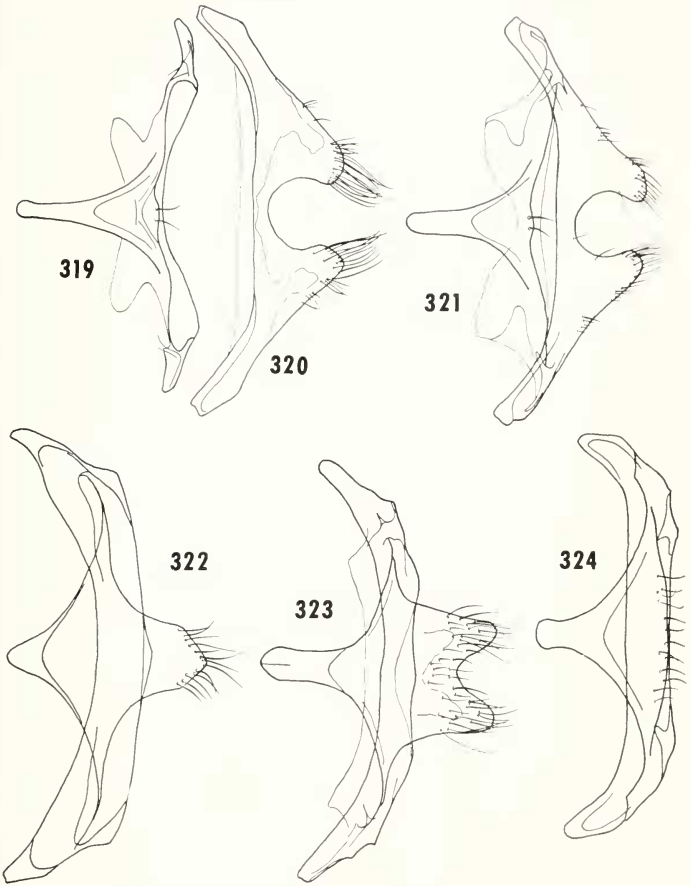
FIGS. **299-305.** Metasomal sterna of male Augochlorini, anterior edges to left. **299-301,** *Thectochlora alaris* (Vachal) (299, sternum VIII; 300, sternum VII; 301, sterna VII and VIII fused); **302-304,** *Augochlora (Augochlora) pura* (Say) (302, sternum VIII; 303, sternum VII; 304, sterna VII and VIII fused); **305,** sterna VII and VIII fused of *Augochlora (Oxystoglossella) cordiaefloris* (Cockerell).



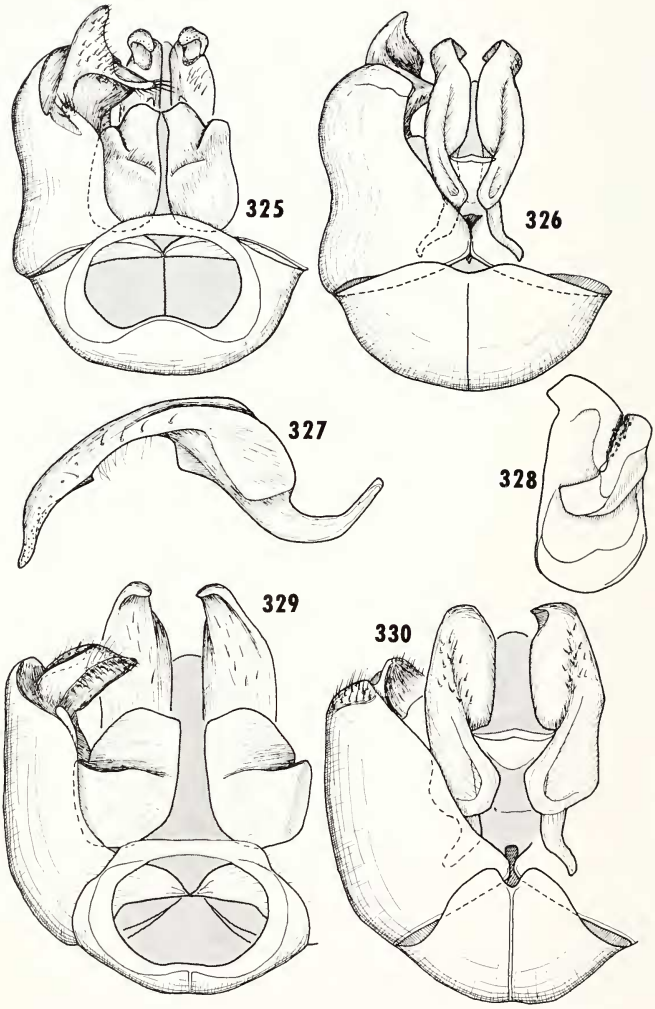
Figs. **306-313.** Metasomal sterna of male Augochlorini, anterior edges to left. **306,** sterna VII and VIII fused of *Augochlora (Mycterochlora) repandirostris* (Vachal); **307-309,** *Augochlorella striata* (Provancher) (307, sternum VIII; 308, sternum VII; 309, sterna VII and VIII fused); **310-312,** *Ceratalictus theia* (Schrottky) (310, sternum VIII; 311, sternum VII; 312, sterna VII and VIII fused); **313,** sterna VII and VIII fused of *Pereirapis* sp.



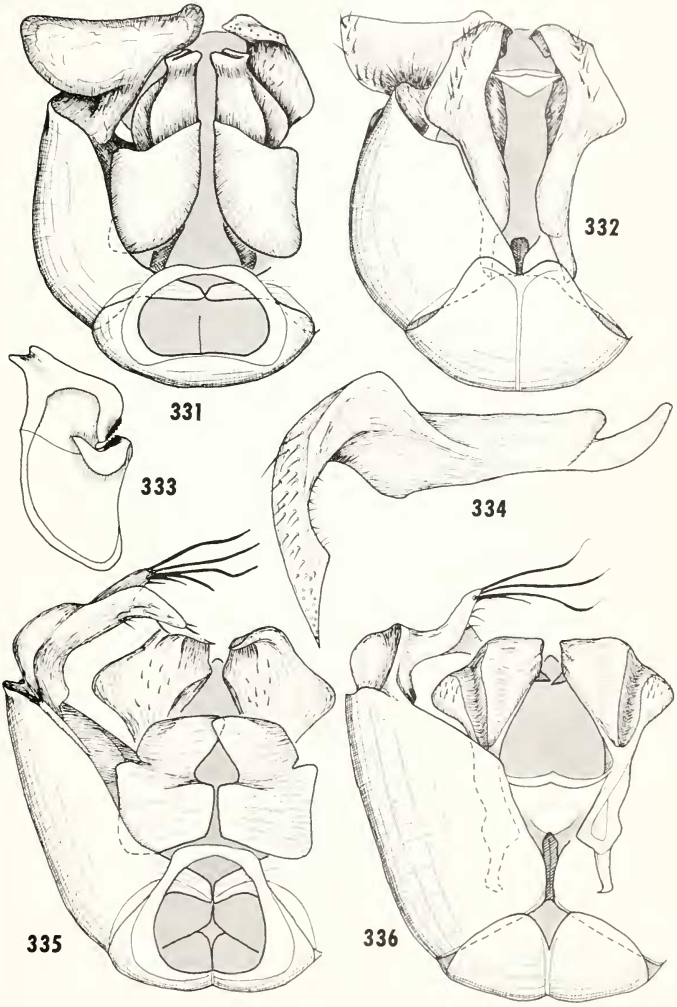
FIGS. **314-318.** Metasomal sterna of male Augochlorini, anterior edges to left. **314-316,** *Caenaugochlora (Caenaugochlora) costaricensis* (Friese) (314, sternum VIII; 315, sternum VII; 316, sterna VII and VIII fused); **317,** sterna VII and VIII fused of *Caenaugochlora (Ctenaugochlora) perpectinata* (Michener); **318,** sterna VII and VIII fused of *Temnosoma smaragdinum* Smith.



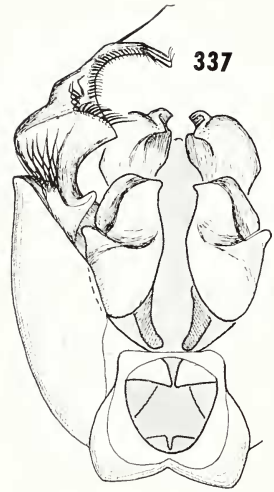
Figs. **319-324.** Metasomal sterna of male Augochlorini, anterior edges to left. **319-321,** *Megalopta genalis* Meade-Waldo (319, sternum VIII; 320, sternum VII; 321, sterna VII and VIII fused); **322,** sterna VII and VIII fused of *Megommation (Megaloptina)* sp.; **323,** sterna VII and VIII fused of *Megommation (Megommation) insigne* (Smith); **324,** sterna VII and VIII fused of *Ariphanarthra palpalis* Moure.

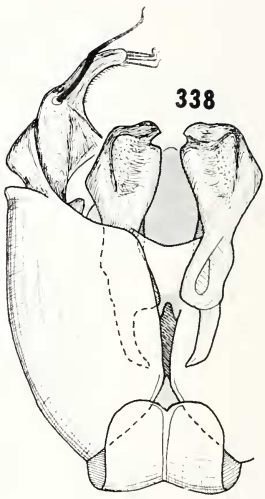


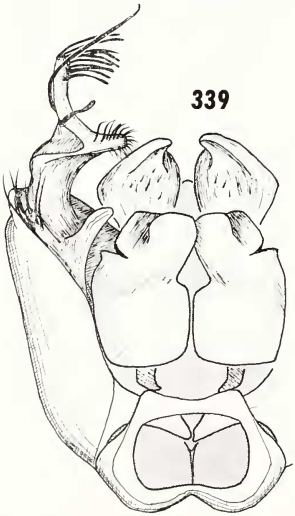
FIGS. **325-330.** External genitalia of male Augochlorini. **325-328,** *Corynura (Corynura) chilensis* (Spinola) (325, ventral view; 326, dorsal view; 327, penis valve, lateral view; 328, volsella, inner view); **329-330,** *Corynura (Callochlora) chloris* (Spinola) (329, ventral view; 330, dorsal view).



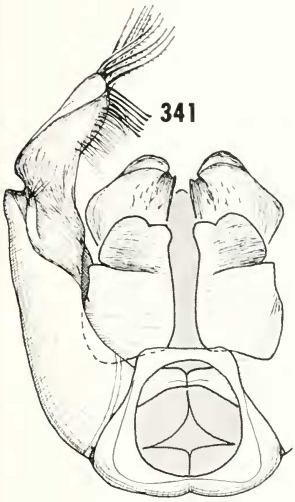
Figs. **331-336.** External genitalia of male Augochlorini. **331-334,** *Halictillus* sp. (331, ventral view; 332, dorsal view; 333, volsella, inner view; 334, penis valve, lateral view); **335-336,** *Corynurella mourei* n. sp. (335, ventral view; 336, dorsal view).

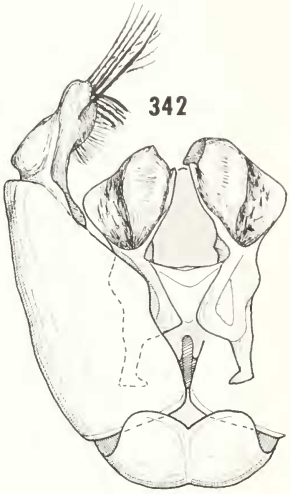


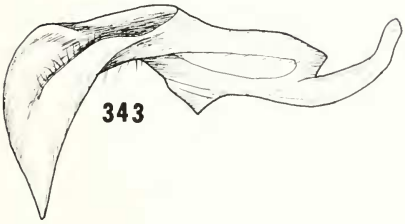




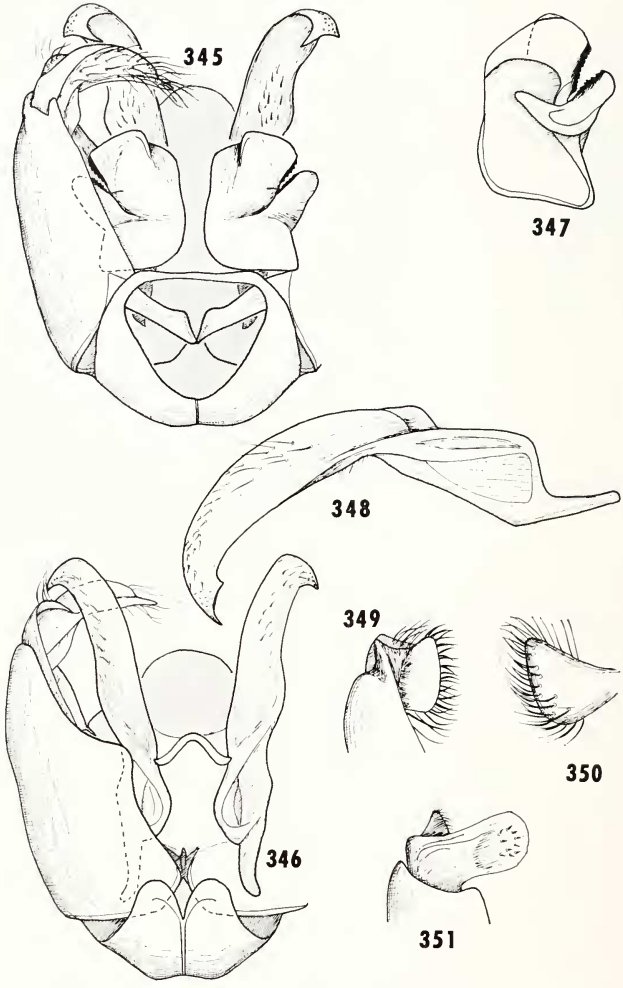
FIGS. 337-340. External genitalia of male Augochlorini. 337-338, *Rhinocoryntura* sp. (337, ventral view; 338, dorsal view); 339-340, *Rhinocoryntura inflaticeps* (Ducke) (339, ventral view; 340, penis valve, dorsal view).



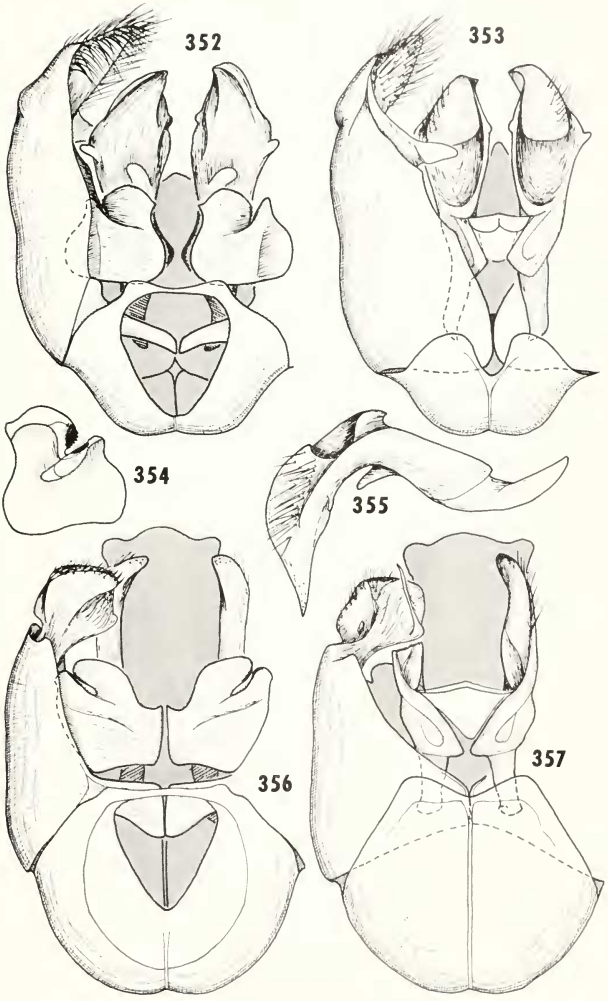




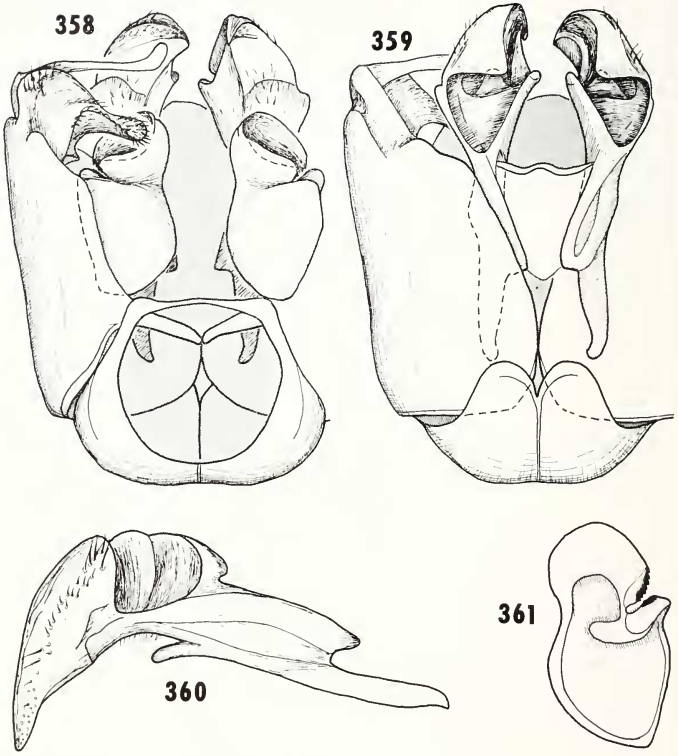
Figs. 341-344. External genitalia of *Rhinocorynura briseis* (Smith) male. 341, ventral view; 342, dorsal view; 343, penis valve, lateral view; 344, volsella, inner view.



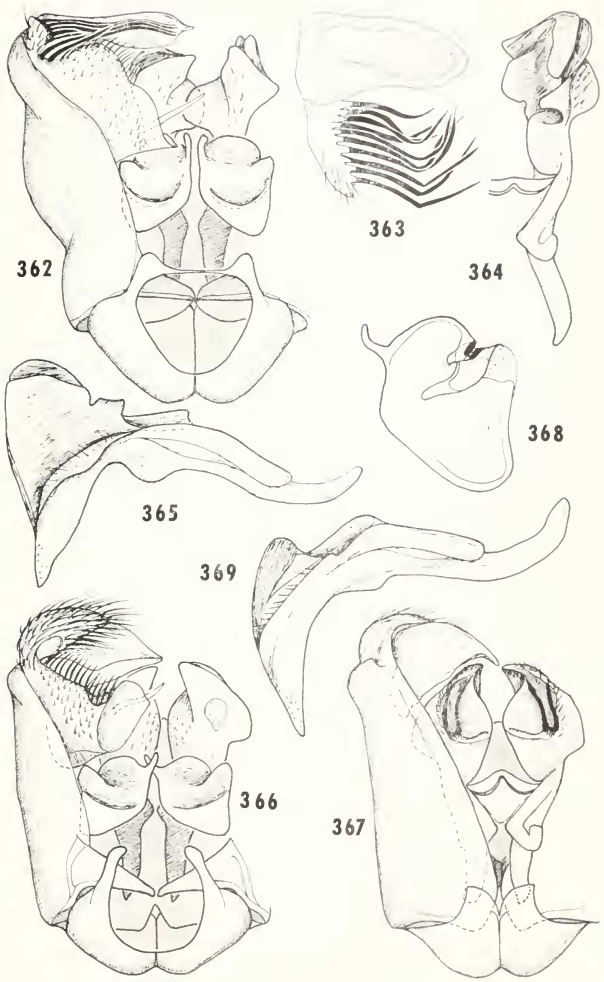
FIGS. **345-351.** External genitalia of male Augochlorini. **345-348,** *Neocorynura (Neocorynura) pubescens* (Friese) (345, ventral view; 346, dorsal view; 347, volsella, inner view; 348, penis valve, lateral view); **349-351,** *Neocorynura (Neocorynuroides) rhytis* (Vachal) (349, gonostylus, ventral view; 350, gonostylus, inner view; 351, gonostylus, dorsal view).



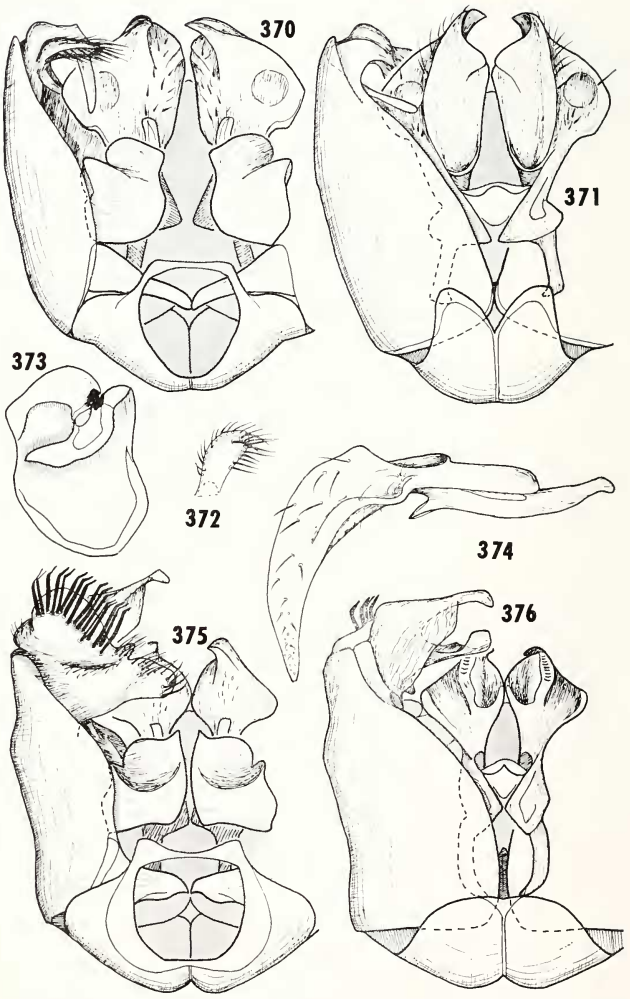
Figs. **352-357.** External genitalia of male Augochlorini. **352-355,** *Paroxystoglossa transversa* Moure (352, ventral view; 353, dorsal view; 354, volsella, inner view; 355, penis valve, lateral view); **356-357,** *Chlerogas ?chlerogas* (Vachal) (356, ventral view; 357, dorsal view).



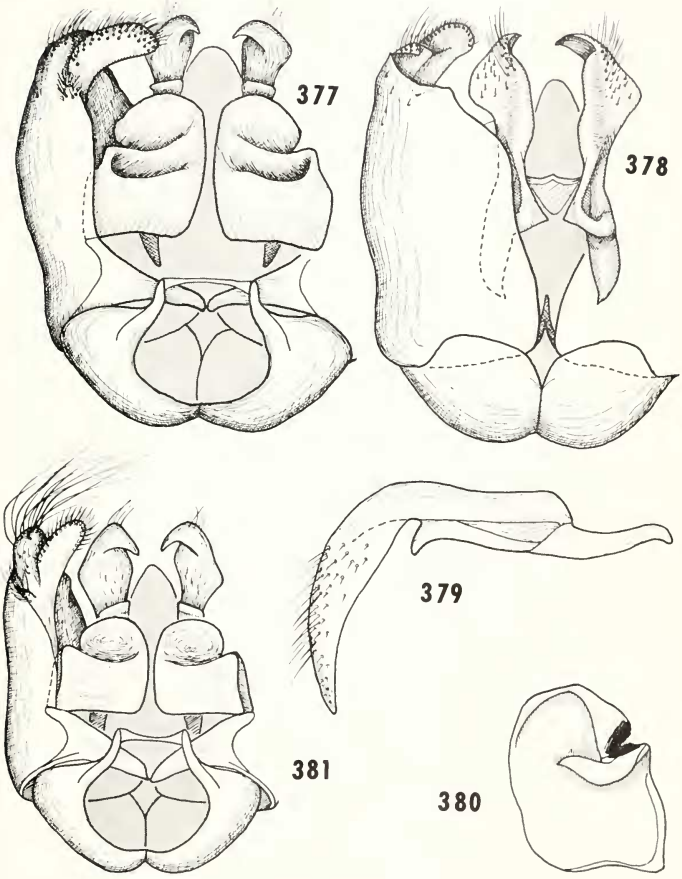
FIGS. **358-361.** External genitalia of *Andinangochlora micheneri* n. sp. male. **358,** ventral view; **359,** dorsal view; **360,** penis valve, lateral view; **361,** volsella, inner view.



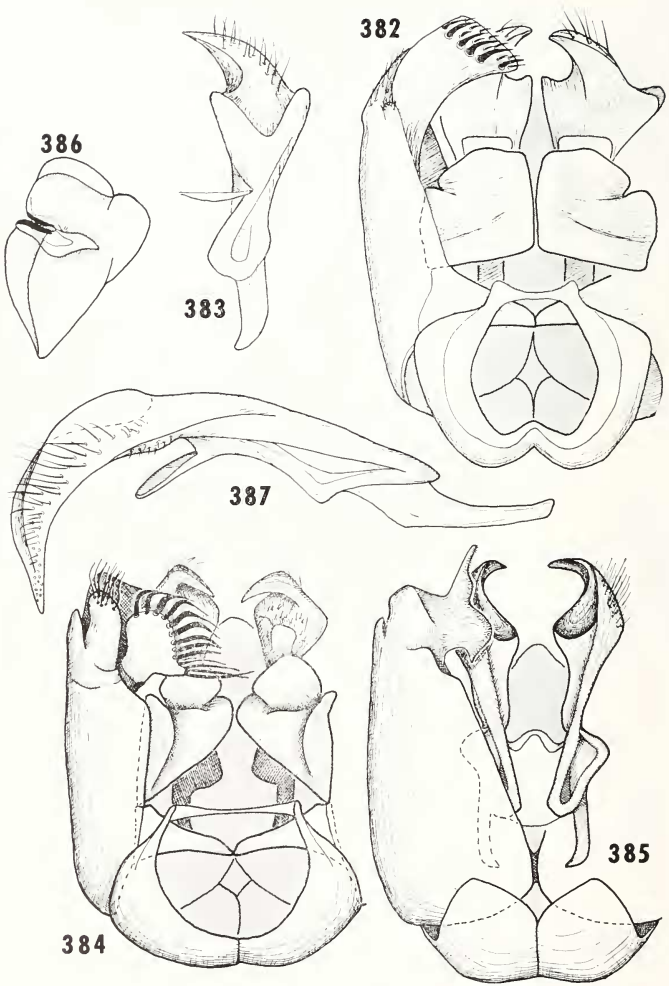
Figs. 362-369. External genitalia of male Augochlorini. 362-365, *Augochlora (Augochloropsis) ignita* (Smith) (362, ventral view; 363, gonost lus, apical view; 364, penis valve, dorsal view; 365, penis valve, lateral view); 366-369, *Augochloropsis (Paraugochloropsis) metallica* (Fabricius) (366, ventral view; 367, dorsal view; 368, volsella, inner view; 369, penis valve, lateral view).



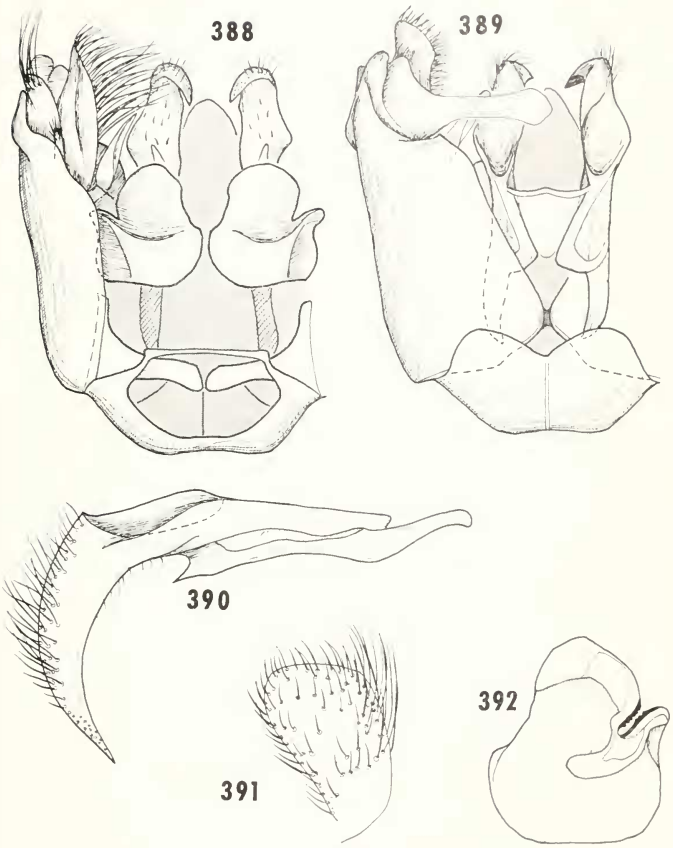
FIGS. **370-376.** External genitalia of male Augochlorini. **370-374,** *Thectochlora alaris* (Vachal) (370, ventral view; 371, dorsal view; 372, gonostylus, inner view; 373, volsella, inner view; 374, penis valve, lateral view); **375-376,** *Augochlorodes turrifaciens* Moure (375, ventral view; 376, dorsal view).



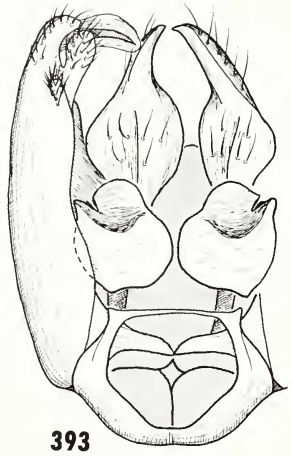
Figs. **377-381.** External genitalia of male Augochlorini. **377-380.** *Augochlora (Augochlora) pura* (Say) (377, ventral view; 378, dorsal view; 379, penis valve, lateral view; 380, volsella, inner view); **381,** ventral view, *Augochlora (Oxystoglossella) cordiaefloris* Cockerell.

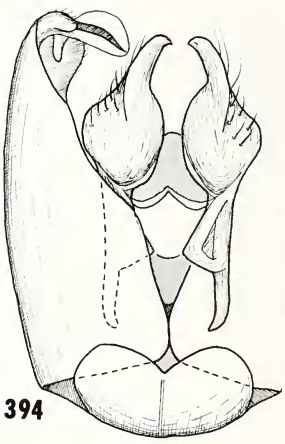


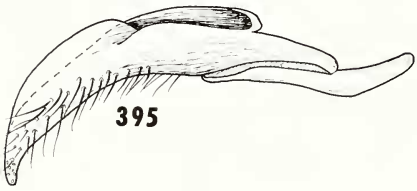
FIGS. 382-387. External genitalia of male Augochlorini. **382-383,** *Augochlora (Mycterochlora) repandirostris* (Vachal) (382, ventral view; 383, penis valve, dorsal view); **384-387,** *Augochlorella striata* (Provancher) (384, ventral view; 385, dorsal view; 386, volsella, inner view; 387, penis valve, lateral view).

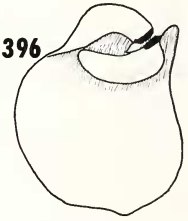


Figs. 388-392. External genitalia of *Ceratalictus theca* (Schrottky) male. 388, ventral view; 389, dorsal view; 390, penis valve, lateral view; 391, gonostylus, inner view; 392, volsella, inner view.

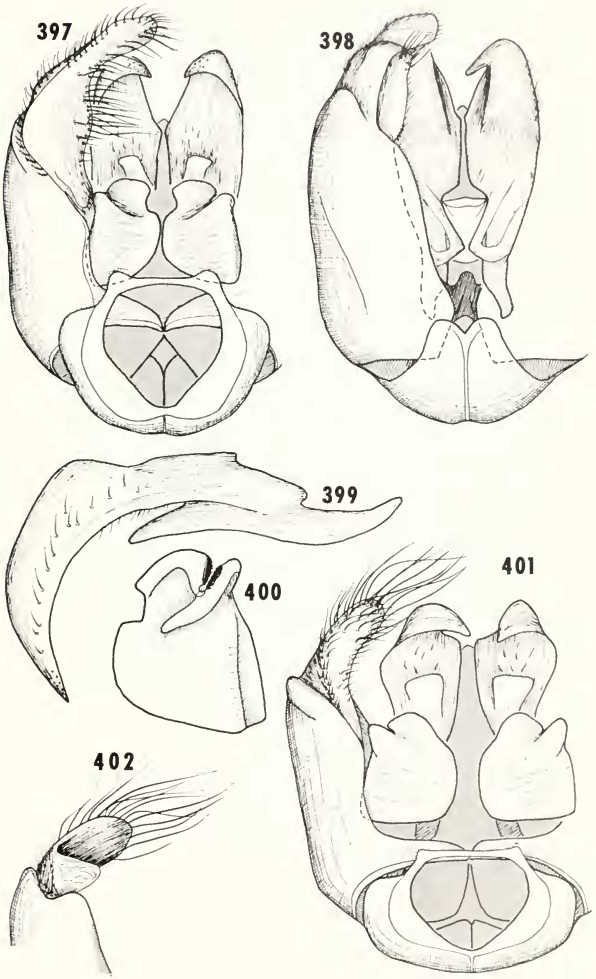




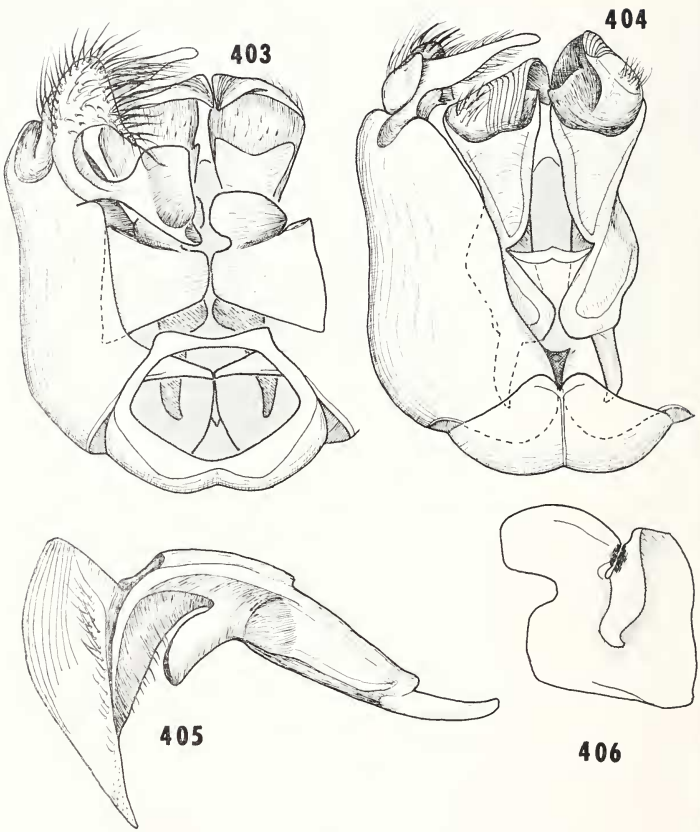




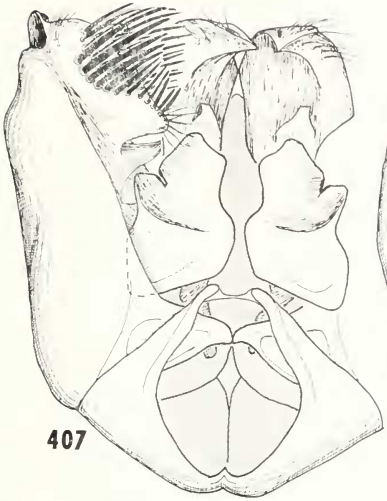
FIGS. 393-396. External genitalia of *Pereirapis* sp. male. **393,** ventral view, **394,** dorsal view; **395,** penis valve, lateral view; **396,** volsella, inner view.



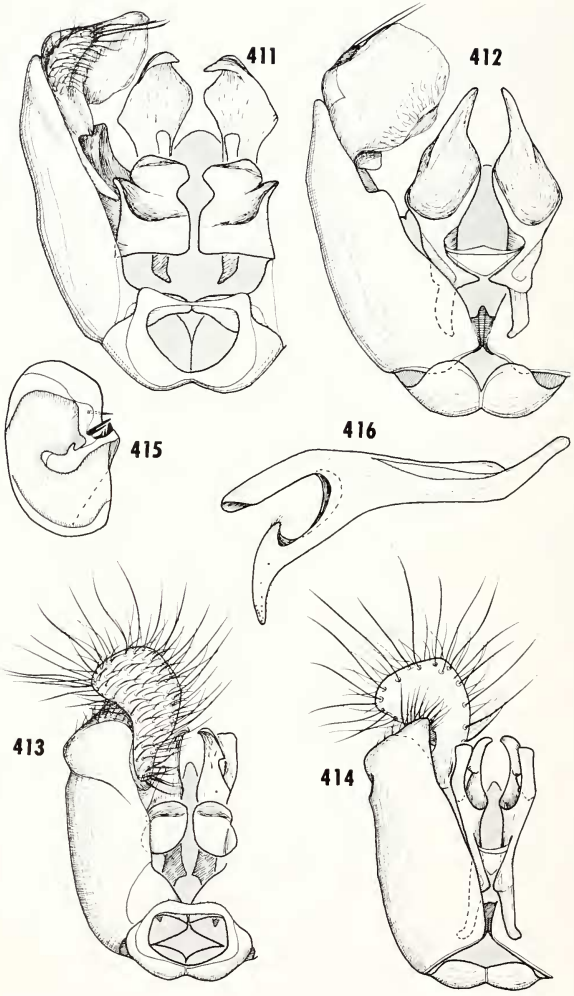
Figs. **397-402.** External genitalia of male Augochlorini. **397-400,** *Caenaugochlora (Caenaugochlora) costaricensis* (Friese) (397, ventral view; 398, dorsal view; 399, penis valve, lateral view; 400, volsella, inner view); **401-402,** *Caenaugochlora (Ctenaugochlora) perpectinata* (Michener) (401, ventral view; 402, gonostylus, dorsal view).



FIGS. 403-406. External genitalia of *Megalopta genalis* Meade-Waldo male. **403,** ventral view; **404,** dorsal view; **405,** penis valve, lateral view, crest expanded; **406,** volsella, inner view.



Figs. 407-410. External genitalia of male Augochlorini. 407-408, *Megommation (Megommation) insigne* (Smith) (407, ventral view; 408, dorsal view); 409-410, *Megommation (Megaloptina)* sp. (409, ventral view; 410, dorsal view).



FIGS. **411-416.** External genitalia of male Augochlorini. **411-412,** *Ariphanarthra palpalis* Moure (411, ventral view; 412, dorsal view); **413-416,** *Temnosoma smaragdinum* Smith (413, ventral view; 414, dorsal view; 415, volsella, inner view; 416, penis valve, lateral view).

DISCUSSION

Estimation of relationships. As pointed out by Sokal and Sneath (1963), two types of relationship among taxa are of interest to systematists: *phenetic* relationship which deals with the overall similarity of organisms, and *cladistic* relationship which deals with paths of evolutionary lineage. In the absence of fossils, both types of relationship are ascertained from the same data, by examining contemporary organisms.

All genera of the Augochlorini represent, I believe, "natural" taxa in the usual cladistic sense. That is, they are monophyletic, the species in each genus presumably having arisen by cleavage of a common stem species. I arrived at this conclusion after examining many species; in each genus the species are linked by common characteristics which in my opinion are indicative of common ancestry. The complex external male genitalia provide especially important evidence, as species in each genus have similar genitalia but the basic structural plan for each genus is usually distinctive.

Of course, the genera differ as to the amount of phenetic variability their species exhibit around common generic structural plans. Some genera are "cohesive" or "closely-knit" in that their species are very similar in all characters; these genera frequently possess distinctive characters which readily separate them from all other genera. Other genera are less cohesive in that their species are more variable; these genera often are less distinctly separated from phenetically related genera. However, if male genitalia are taken into account, generic limits of even loosely-knit genera are rather easy to recognize in comparison with many groups of insects. In only the *Rhinocorynura* and *Megaloptidia* groups of genera (as delimited below) are the genera so similar or poorly known that generic limits proved difficult to ascertain and are somewhat arbitrarily drawn.

If one accepts as a working hypothesis that the genera recognized in this paper are "natural" cladistic units, they may be used as operational taxonomic units (see Sokal and Sneath, 1963) in phenetic and cladistic studies to determine relationships among genera and possible evolutionary paths followed by the Augochlorini. A numerical analysis was undertaken to aid in ascertaining overall phenetic similarities among augochlorine genera, using a large number of characters, equally weighted. (See the section on Methods for further details and Sokal and Sneath, 1963, for the special terminology of numerical taxonomy.) The validity of this analysis depends upon the accuracy of the character coding and to some extent on the choice of characters. Some characters were easily coded (such as the epistomal sulcus and the hypostomal length) and thus are ideally suited for numerical analysis, while others could not be coded satisfactorily (particularly characters of the metasomal sterna and the genitalia), and their contributions to overall phenetic similarity are poorly indicated in the numerical analysis.

Estimations of cladistic relationship take into account convergence and direction of evolution, and disregard the rate of evolution and thus, theoretically, the degree of phenetic similarity. When my estimate of cladistic relationship differs from the estimate of phenetic affinity provided by the numerical analysis, it is usually due to my weighting of characters that appear to be of importance due to their complexity, for instance the galeal comb and the male genitalia. The generic groups denoted below are a product of both phenetic and cladistic analysis. While the numerical analysis was used as an aid in formulating these groups, often providing welcome support for groups recognized before the numerical study was made, the groupings accepted are not all justified by the analysis and those that are recognized are not joined at the same phenon levels. On the other hand, no groups were formulated by clustering very dissimilar taxa (as indicated by the numerical analysis) because they were linked by some common character that I deemed of special cladistic importance.

Summary of the numerical analysis. Cluster analyses based on both the correlation and distance coefficients created initial clusters which largely agree with my previous concepts as to what constitute "natural" cladistic and phenetic groupings. Subsequent levels of clustering, as shown in the phenograms (Figs. 417-418) are not reliable; relationships which are evident in the correlation and distance matrices are frequently hidden in the phenograms. The two cluster analyses largely agree between themselves on initial groupings but frequently disagree as to larger (i.e. subsequent) clusters. The analysis based upon correlation coefficients (Fig. 418) better delimits groups that were apparent to me before the analysis, but the analysis based upon distance coefficients (Fig. 417) sets distinctly different genera (e.g., *Temnosoma*) further apart from the other genera. The cophenetic value of the distance phenogram is .91 and of the correlation phenogram, .85, each with its own matrix.

Generic groups. Most of the genera of the Augochlorini fall into seven more-or-less well-defined generic groups. Relationships among the generic groups are for the most part difficult to interpret.

CORYNURA GROUP. *Corynura, Callochlora,* and *Halictillus* form a cohesive group of South Temperate species, most of which resemble nonaugochlorine halictines. The form of the mouthparts, galeal comb, largely dull coloring, and the striking resemblance of *Halictillus* to *Dialictus* (except for the genitalia and hidden sterna) suggest that the *Corynura* group may be important in ascertaining cladistic relationship of the Augochlorini to other groups of bees. The phenograms suggest that *Halictillus* should perhaps be considered only subgenerically distinct from *Corynura,* but the numerical analysis does not adequately take into consideration the form of the male genitalia, which is quite different in *Halictillus* from that in *Corynura* and *Callochlora.*

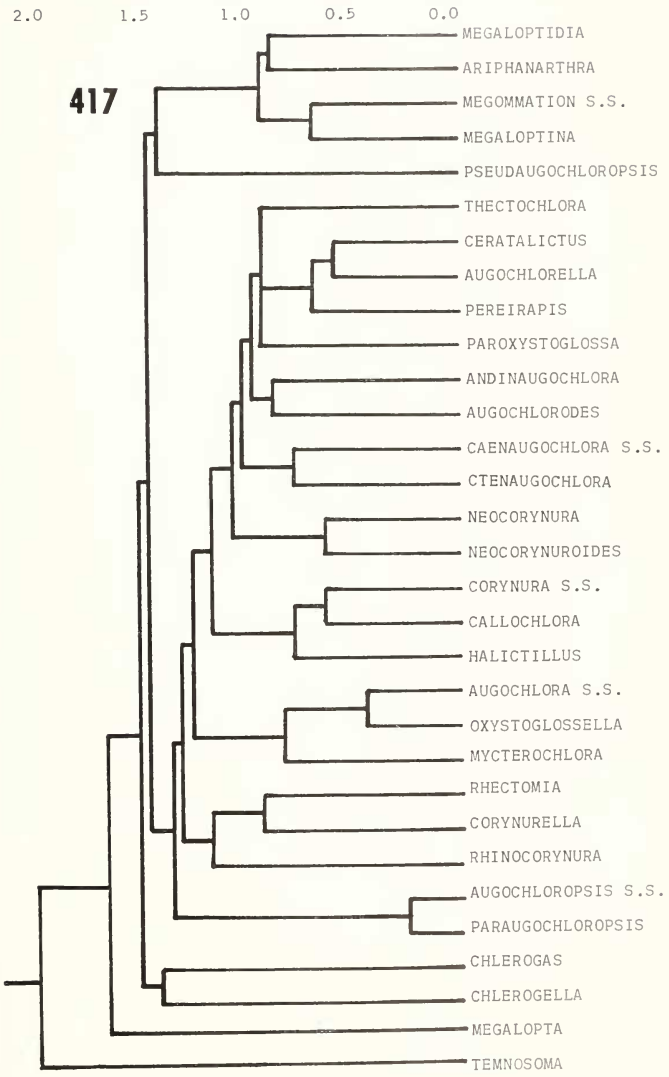


Fig. 417. Phenogram of the Augochlorini based upon the distance matrix.

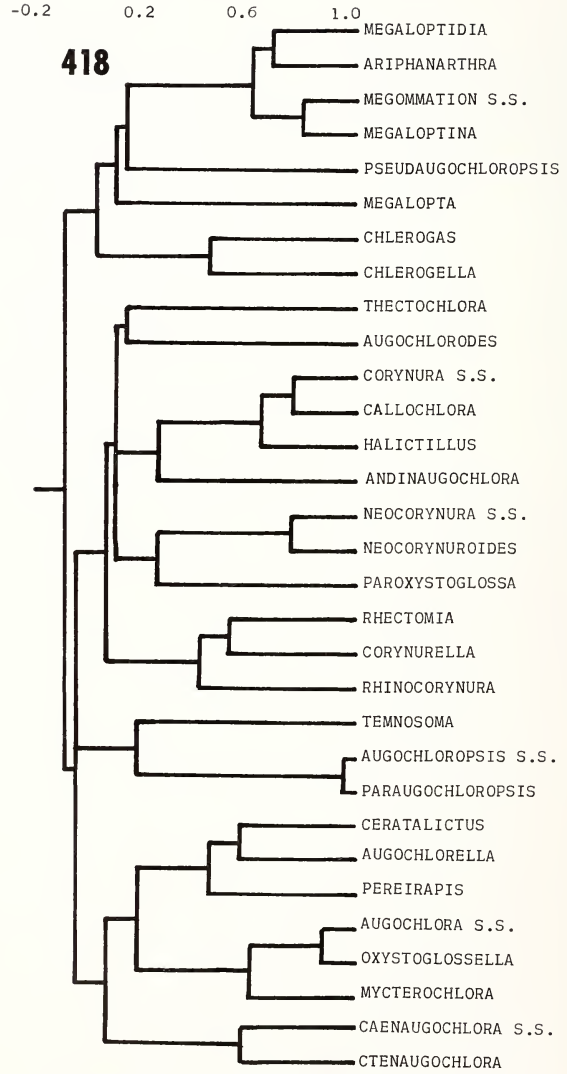


FIG. 418. Phenogram of the Augochlorini based upon the correlation matrix.

RHINOCORYNURA GROUP. *Rhinocorynura, Corynurella,* and *Rhectomia* comprise another cohesive group of largely dull bees, linked by common plans of mouthparts and male genitalic and hidden sternal and tergal structure. A cladistic relationship to the *Corynura* group is suggested by a number of characters, especially the mouthparts; the *Rhinocorynura* group occupies a range on the northern border of that of the *Corynura* group. *Rhectomia,* like *Halictillus,* superficially resembles *Dialictus.* Both distance and correlation phenograms recognize the *Rhinocorynura* group, but both separate it slightly from the *Corynura* group. However, *Rhectomia* is most similar outside its group in the distance matrix to *Corynura* (1.034), and in the correlation matrix to *Halictillus* (0.335); *Corynurella* is next most similar outside its group in the correlation matrix to *Halictillus* (it is most similar to *Chlerogella*), although it is more distant in the distance matrix (1.231 to *Corynura*); and *Rhinocorynura* is most similar outside its group in the correlation matrix (0.165) and next most similar in the distance matrix (1.310) to *Corynura.* These values suggest a greater similarity to the *Corynura* group than either of the phenograms implies.

NEOCORYNURA GROUP. *Neocorynura, Neocorynuroides, Paroxystoglossa, Andinaugochlora* and *Chlerogas* form a loosely knit group. *Neocorynura* is the largest and most widespread genus of the group, its range overlapping all of the others, and consequently is the genus with which the others of the group should be compared.

The Peruvian genus *Chlerogas* resembles at least one species of *Neocorynura* in its bituberculate scutellum; and the genitalia, with the narrow penis valves, are also similar; *Chlerogas* could not be compared as to its mouthparts and characters of the female, and consequently its relationships are inconclusive. Both phenograms indicate that *Chlerogas* and *Chlerogella* are most similar to each other; this is probably due to convergence in the lengthening of the head and the large number of "no comparisons" for both genera, since each is known from only one sex. Both matrices suggest a close similarity of *Chlerogas* to *Andinaugochlora,* closest in the distance matrix (1.111) and next closest in the correlation matrix (9.262) (after *Chlerogella*).

The Andean genus *Andinaugochlora* resembles Andean species of *Neocorynura* in general appearance as well as in the mouthparts (especially the small galeal comb) and long male antennae, but has quite different male genitalia, and also resembles *Caenaugochlora,* especially in the marginal cell, and epistomal sulcus. Neither phenogram places *Andinaugochlora* close to *Neocorynura.* The distance matrix places *Andinaugochlora* nearest to *Augochlorella* (9.896) and the correlation matrix to *Halictillus* (9.262), neither of which is very closely related cladistically to *Andinaugochlora* in my opinion. Until the Andean Halictinae are much more thoroughly collected and studied, the cladistic relationships of *Andinaugochlora* will remain in doubt.

Species of *Paroxystoglossa* occur on the southern margins of the range of *Neocorynura* and most females in particular are very similar to species of that genus. The correlation phenogram clusters *Paroxystoglossa* and *Neocorynura* together, although the distance phenogram does not, and the distance matrix places *Paroxystoglossa* nearest to *Augochlorella* (9.928).

Neocorynura resembles *Corynura* in the galeal comb and to some extent in genitalic characters. Early workers usually synonymized *Neocorynura* and *Corynura* on account of the long petiolate metasoma of the male, common to both. Both phenograms suggest a similarity of the *Corynura* group to *Neocorynura*. Outside its group the greatest similarity to *Neocorynura s. s.* in the correlation matrix and next closest in the distance matrix is with *Corynura*.

AUGOCHLOROPSIS GROUP. The large widespread genus *Augochloropsis s. l.* and the small southern Brazilian genus *Augochlorodes* form a small group not obviously related cladistically to any other group, and phenetically distinct as indicated by the low clustering level of *Augochloropsis* on both phenograms. The correlation matrix and phenogram would suggest a similarity of *Augochloropsis* to *Temnosoma* at a low level (0.174), but there is little reason to suggest a close cladistic relationship. The distance matrix places *Augochloropsis* nearest to *Thectochlora* at a low level of similarity (1.185). The very close similarity between *Augochloropsis s. s.* and *Paraugochloropsis* suggested by the phenograms may in part be due to the difficulties in coding genitalic characters.

Augochlorodes is placed in a group with *Augochloropsis* on the basis of the structure of its head and mouthparts and male sternal and genital characteristics, although *Augochlorodes* lacks most of the other distinctive characteristics of *Augochloropsis*. Neither of the phenograms clusters *Augochlorodes* closely with any other genus; both matrices place *Augochlorodes* as very slightly more similar to *Andinaugochlora* than to other genera. Neither matrix indicates a particularly close similarity to *Augochloropsis*.

THECTOCHLORA. This is a small genus from the southern Brazilian and Argentinian region which could not be cladistically linked to other genera. While *Thectochlora* is clustered ambivalently in the phenograms, both matrices place it as most similar to *Ceratalictus* (0.861 distance, 0.271 correlation). This is not necessarily an indication of cladistic relationship, in my opinion.

AUGOCHLORA GROUP. *Augochlora, Oxystoglossella, Mycterochlora, Augochlorella, Ceratalictus,* and *Pereirapis* form a cohesive widespread group. Vachal (1911) had recognized the *Augochlora* group as the *Halicti falcati*, and it largely corresponds with Moure's (1943) original Augochlorini. The group is united phenetically by such characters as a common tibial spur form and basic genitalic structure. The correlation phenogram also reflects my concepts concerning the cladistic relationships within the group, with *Mycterochlora* being less similar and less related cladistically to *Augochlora*

s. s. than is *Oxystoglossella,* and *Ceratalictus* being very similar and closely related cladistically to *Augochlorella.* The distance phenogram separates *Augochlora s. l.* from the other members of the group, but this appears to be misleading, as in the matrix, *Oxystoglossella* shows the highest similarity outside its genus to *Augochlorella* (0.989), as does *Augochlora s. s.* (1.094). The cladistic relationships of the *Augochlora* group to other groups are obscure; *Ceratalictus* with its obtuse epistomal sulcus, short glossa, lack of unique features found in other genera of the group, and southern range, may prove to be the most primitive and an important connecting link, perhaps to *Paroxystoglossa.* Both matrices suggest that *Ceratalictus* is most similar to *Thectochlora* outside its group.

PSEUDAUGOCHLOROPSIS GROUP. *Pseudaugochloropsis, Caenaugochlora,* and *Ctenaugochlora* form a loosely knit group of bees with long glossae and characteristically modified metasomal sterna IV of the males. *Caenaugochlora s. l.* is characterized by such interesting features as spiculum-like anterior apodemes on metasomal sterna VI and VII of the males and long hair on the eyes. Despite the fact that some females of *Caenaugochlora s. l.* can be separated from *Pseudaugochloropsis* only with difficulty and the mouthparts are usually quite similar, neither the phenograms nor matrices indicate strong similarity between the two. Both *Caenaugochlora* and *Pseudaugochloropsis* are clustered with different genera at low levels in the two numerical analyses. The form of the mouthparts and epistomal sulci suggest a possible cladistic relationship with the *Megaloptidia* group.

MEGALOPTA. This genus exhibits such a variety of unusual characteristics, including the continuous row of hamuli, female labral structure, pronotal structure, and male genitalia, that it could not be placed with certainty in any group. The structure of the mouthparts, characteristics of the male sterna, and long marginal cell (as in *Caenaugochlora*) suggest a possible cladistic relationship with the *Pseudaugochloropsis* group. The enlarged eyes and ocelli and general appearance also are similar to those of members of the *Megaloptidia* group, as shown in the correlation phenogram. In the correlation matrix, *Megalopta* is closest to *Pseudaugochloropsis,* although at a low level of similarity (0.113). The distance phenogram shows *Megalopta* to be one of the most distinctive of the genera; the matrix indicates no closely similar genera. Examination of the males of the small-eyed species of *Megalopta* may give further clues as to the genera which may be most closely related cladistically to it.

MEGALOPTIDIA GROUP. *Megommation, Megaloptina, Megaloptidia* and *Ariphanarthra* form a closely knit group of rather shiny bees characterized in particular by their unique, long, slender mouthparts. The scarceness of males in collections hampered analysis of cladistic relationships within the group. Both phenograms clearly distinguish the group and portray com-

parable intragroup similarities, reflecting my ideas of cladistic relationship. The *Megaloptidia* group appears to be most closely related cladistically to the *Pseudaugochloropsis* group, and its similarity to the latter is suggested by both phenograms and the correlation matrix; both *Megommation s. l.* and *Ariphanarthra* have their highest correlations outside their group with *Pseudaugochloropsis,* although at low levels, 0.194 *(Megaloptina)* and 0.160 *(Ariphanarthra).*

CHLEROGELLA. This genus cannot as yet be placed into a group, as it is known from a single female and is unusual in several respects, notably the elongate head and the pronotal structure. The phenetic clustering of *Chlerogella* with *Chlerogas* is quite probably artificial and does not reflect cladistic relationship, as both are known only from one sex (in *Chlerogas,* the male) and both have elongate heads. In general appearance, color, and the long marginal cell, *Chlerogella* somewhat resembles *Corynurella,* to which it is most similar in the distance matrix (1.381) and second most similar (following *Chlerogas*) in the correlation matrix (0.277); whether this indicates a cladistic relationship is uncertain.

TEMNOSOMA. This genus appears to be the most distinctive genus, and this is confirmed by the distance phenogram. The correlation matrix suggests a similarity to *Augochloropsis,* although the correlation is low (0.179 with *Augochloropsis s. s.*), but the matrix shows that correlations are negative or nearly so with all other genera. A cladistic relationship with *Augochloropsis* is not suggested by most characters in this study, although *Augochloropsis* does contain some coarsely punctate species which suggest a resemblance to *Temnosoma,* unlike most other genera.

Phylogenetic speculations: Cladistic analysis and the construction of "phylogenetic trees" requires that the primitive and advanced states of characters be ascertained. While such decisions are speculative for the Augochlorini, they are of heuristic value; therefore, Table 1 lists for certain characters the probable primitive and advanced states, based on comparisons with other bees outside the Augochlorini, sometimes outside the Halictinae.

Using the characters in this table, it is possible to speculate further on which genera are primitive and on lines of evolution. The *Corynura* group appears to be the most primitive group, as particularly indicated by the well-developed galeal comb; short, wide mouthparts; and usually non-brilliant coloring. If the *Corynura* group is accepted as a base for evolution, then the *Rhinocorynura* group is closely related cladistically, sharing many of the primitive characters. Both the *Corynura* and *Rhinocorynura* groups occupy ranges in temperate and subtropical South America.

The *Neocorynura* group appears to be an evolutionary offshoot of the *Corynura* group that has successfully radiated in the tropics and undergone a great amount of speciation. Many of the specializations of *Neocorynura*

Table 1. Primitive *vs* Specialized Features of Augochlorine Genera.*

Character	Primitive	Specialized
angle of epistomal sulcus	obtuse	acute
clypeus	normal	flattened, protuberant, or projecting beyond margin
clypeal modifications	normal	tuberculate or spined
malar area	normal	elongate
preoccipital ridge	rounded	carinate
hypostoma	short and wide	long and narrow
emargination of compound eye	shallow	deep
eye hair	normal	long
ocelli	normal	enlarged
mandibular tooth	normal	absent or enlarged
maxillary anterior conjunctival thickenings	joining distally	normal
apex of galea	normal (lobed)	pointed
galeal comb	present	absent
maxillary palpus	normal	greatly elongate
prementum (anterior surface)	normal	transparent or without premental thickenings
prementum	short and wide	long and narrow
glossa	short	long
mesoscutum	normal	narrowed anteriorly
tegula	normal	modified
distal hamuli	single row	normal
inner hind tibial spur	serrate or pectinate	rounded-serrate or lamellate
scopa	present	absent
basitibial plate	long, all edges defined	short, or all edges not defined, or absent
pseudopygidial area	normal	scaled or absent
sternum I	normal	spined or tuberculate
antenna (male)	normal	hooked or with projections
inner hind tibial spur (male)	normal	knobbed or pectinate
metasoma (male)	oval or elongate	petiolate
sterna III-VI	normal	modified
basal process of ventral gonostylus	present	absent
color	black or dull metallic	bright green or testaceous (orange)

* Normal states are explained in the section on Characters Employed.

heighten the resemblance of these bees to polybiine wasps, which are common in many of the habitats where these bees are found. The question immediately arises whether mimicry is involved, and if the apparent evolutionary success of *Neocorynura* is in part due to it. In most respects species of *Neocorynura* are quite generalized, especially in the mouthparts and the presence of a rudimentary galeal comb.

Augochloropsis is a highly successful product of augochlorine evolution that has spread through most of the tropics and the North Temperate Zone

of the New World. Although the mouthparts of most species are not obviously specialized, many species seem to be adept at gathering pollen from plants in predominantly tropical families (such as Solanaceae and Melastomaceae, as observed in Costa Rica) which require behavioral adaptations on the part of the bees, and this may in part account for the success of the genus. *Augochlorodes* may represent a cladistically more primitive member of the group, but I could not determine from which generic group it might have descended.

Augochlora is also a successful and widespread genus, with an elongate glossa and modifications for wood dwelling in species of the principal subgenus. *Augochlora* is the end of a cladistic line whose most primitive member, *Ceratalictus,* is in the Southern Hemisphere. *Augochlorella,* less specialized than *Augochlora,* is most numerous in species in temperate North America, less so in the tropics.

The *Pseudaugochloropsis* group appears to represent still another line of evolution, possibly related cladistically to some member of the *Neocorynura* group. The former may be important as a cladistic link to *Megalopta* and the *Megaloptidia* group. *Megalopta* is one of the most specialized genera; many of the modifications of its species apparently are linked to nocturnal habits and wood dwelling. The *Megaloptidia* group also represents a distinctive evolutionary line; the highly modified mouthparts, enlarged eyes and ocelli in some species, and the rareness of specimens in collections despite a wide range of the genera, suggest behavorial specialization.

Temnosoma is apparently the only augochlorine genus whose species are social parasites, judging from the morphology of the adult bees. Phenetically it is the most distinct of the augochlorine genera and its cladistic relationships could not be ascertained. The thick, very coarsely punctate integument and general chrysidid-like appearance of its species suggest that they are even better adapted morphologically to social parasitism than are species of the well known and widespread genus *Sphecodes.*

The above phylogenetic scheme postulates that the most primitive augochlorines (the *Corynura* group) are presently South Temperate in distribution and that the more specialized and cladistically more recent genera are principally tropical. The range of *Corynura,* interestingly, coincides to some extent with the range in America of the most primitive bees, the Paracolletini (Colletidae) (Michener, 1944). It is quite possible, of course, that a member of the *Neocorynura* group was the most primitive and that the *Corynura* group has evolved from it.

The four well-defined generic groups and the other genera are quite distinctly set apart from each other. This is especially apparent when the male genitalia are considered; distinct structural patterns are evident within the genitalia of many genera that are not easily homologized with patterns of

other genera. This is in contrast to most non-augochlorine genera of American halictine bees where the genera are poorly separated and the genitalia follow the same basic structural plan (Eickwort, in preparation). The speculation arises as to whether this indicates that the Augochlorini are the older group of Halictinae in the Americas, having more thoroughly differentiated into supraspecific taxa.

Geographic distribution: Discussion of geographical distribution is severely hampered by the paucity of specimens available from northern and western South America. This is especially evident for the Andes, where comparatively few species have been collected. Unique specimens from the Andes suggest an abundance of new genera, new radiations of previously known genera, and possible links that will help clarify cladistic generic interrelationships. The United States, Mexico, Costa Rica and Panamá, Southern Brazil, Argentina, and Chile have been comparatively well collected for augochlorine bees. Even in these countries, "rare" bees are occasionally encountered that represent new genera. For instance, the single female of *Chlerogella* collected by Michener in Panamá is very different from genera previously known. Moure (1951) has described a similar case in his efforts to obtain specimens of *Ariphanarthra palpalis* in a well-collected area of southern Brazil.

North American halictines are largely polylectic and visit a variety of weedy herbs, and many Latin American halictines follow this pattern, e.g., many *Augochlora (Oxystoglossella)* and *Pereirapis*. But many, and perhaps most, tropical American augochlorine bees appear to be more specific in flower visitation and habitat selection, and this may lead to their being poorly collected, even by experienced collectors in the right geographical locations. For instance, *Megalopta* is a widespread genus of large nocturnal bees, but they are well represented in collections only because they are attracted to lights at night. Specimens collected in daytime are rare.

Eight genera are considered widespread in distribution, ranging from North America or Mexico to Argentina: *Augochlora, Augochloropsis, Augochlorella, Pereirapis, Pseudaugochloropsis, Megalopta, Temnosoma,* and *Neocorynura. Caenaugochlora* and *Megommation* are nearly as widespread, occurring in both Central and South America.

South America north of Argentina and Chile is the center of abundance of augochlorine genera; besides the above-named widespread genera, *Andinaugochlora, Chlerogas, Rhinocorynura, Halictillus, Corynurella, Rhectomia, Paroxystoglossa, Augochlorodes, Thectochlora, Ceratalictus, Megaloptidia,* and *Ariphanarthra* are known from this region. The last ten genera occur from southern Brazil to northern Argentina and may indicate that this region is an important center of diversification, or knowledge of them there may

simply be a result of the intensive collecting in that region and subsequent systematic studies.

The *Corynura* group is the most important component of the fauna of Chile (Moure, 1964); other augochlorine genera (i.e., *Temnosoma*) are rarely collected in the northern region of the country. This group is also conspicuous in the fauna of Argentina, although most of the genera known from southern Brazil are also represented in collections from that country.

While Central America and Mexico are rich in species of the widespread augochlorine genera, only one genus, *Chlerogella,* is known exclusively from this area. The Caribbean region, excluding Trinidad and Cuba, is not well collected. As pointed out by Cockerell (1910), Trinidad should not be included in a discussion of this region, as its faunal connections are with Venezuela. There are no unique augochlorine genera known from the Caribbean; *Augochlora, Pseudaugochloropsis, Neocorynura,* and *Temnosoma* are the only genera I have seen represented from islands other than Trinidad.

Only the northernmost species of five widespread, principally tropical, genera are known from the United States and Canada: *Augochlora, Augochlorella, Augochloropsis, Temnosoma,* and *Pseudaugochloropsis* (Ordway, 1966). The latter two genera are known in the United States only from southern Arizona and southern Texas, respectively.

LITERATURE CITED

Alfken, J. D. 1926. Die mir bekannten chilenischen Arten der Bienengattung *Corynura* M. Spinola. Deut. Entomol. Z. 1926:145-163.

———. 1931. Ein weiterer Beitrag zur Kenntnis der chilenischen Arten der Bienengattung *Corynura* M. Spin. (Hym.). Stettiner Entomol. Zeit. 92:211-218.

Ashmead, W. H. 1899. Classification of the bees, or the superfamily Apoidea. Trans. Amer. Entomol. Soc. 26:49-100.

Batra, S. W. T. 1964. Behavior of the social bee, *Lasioglossum zephyrum,* within the nest (Hymenoptera: Halictidae). Insectes Sociaux 11:159-186.

———. 1968. Behavior of some social and solitary halictine bees within their nests: a comparative study (Hymenoptera: Halictidae). J. Kansas Entomol. Soc. 41:120-133.

Beck, D. E. 1933. A morphological study of the male genitalia of various genera of bees. Proc. Utah Acad. Sci. 10:89-137.

Bigelow, R. S. 1954. Morphology of the face in the Hymenoptera. Can. J. Zool. 32:378-392.

Blüthgen, P. 1928. Beitrag zur Kenntnis der äthiopischen *Halictinae.* (Hym. Apid.). Deut. Entomol. Z 1928:49-72.

Braue, A. 1913. Die Pollensammelapparate der beinsammelnden Bienen. Jenäischen Z. 50:1-96, 4 pl.

Camargo, J. M. F. de, W. E. Kerr and C. R. Lopes. 1967. Morfologia externa de *Melipona (Melipona) marginata* Lepeletier (Hymenoptera, Apoidea). Papéis Avulsos Zool. São Paulo 20:229-258, pls. A-P.

Cockerell, T. D. A. 1897. On the Mexican bees of the genus Augochlora. Can. Entomol. 29:4-6.

———. 1900. Descriptions of new bees collected by Mr. H. H. Smith in Brazil.—I. Proc. Acad. Natur. Sci. Philadelphia 52:356-377.

———. 1901. Descriptions of new bees collected by Mr. H. H. Smith in Brazil.—II. Proc. Acad. Natur. Sci. Philadelphia 53:216-222.

———. 1905a. Notes on some bees in the British Museum. Trans. Amer. Entomol. Soc. 31:309-364.
———. 1905b. Some American halictine bees in the British Museum. The Entomologist 38:33-37.
———. 1910. Some bees of the genus Augochlora from the West Indies. Proc. U.S. Nat. Mus. 37:489-494.
———. 1919a. A new genus of bees from Peru (Hym.). Entomol. News 30:17-18.
———. 1919b. Neocorynura, a genus of halictine bees (Hym.). Entomol. News 30:41-42.
———. 1923. Some bees from British Guiana. Ann. Mag. Natur. Histor. (9)11:442-459.
———. 1930. Descriptions and records of bees.—CXXII. Ann. Mag. Natur. Histor. (10)5:156-163.
Cruz Landim, C. da. 1967. Estudo comparativo de algumas glândulas das abelhas (Hymenoptera, Apoidea) e respectivas implicacões evolutivas. Arq. Zool. São Paulo 15:177-290.
Daly, H. V. 1964. Skeleto-muscular morphogenesis of the thorax and wings of the honey bee *Apis mellifera* (Hymenoptera: Apidae). Univ. California Publ. Entomol. 39:1-77.
Demoll, R. 1908. Die Mundteile der solitären Apiden. Z. Wiss. Zool. 91:1-51, pl. I-II.
Ducke, A. 1907. Beitrag zur Kenntnis der Solitärbienen Brasiliens. (Hym.). Z. Syst. Hymenopterologie Dipterologie 7:321-325.
———, 1912. Die natürlichen Bienengenera Südamerikas. Zool. Jahrbuch. abt. Syst. 34:51-116.
DuPorte, E. M., and R. S. Bigelow. 1953. The clypeus and epistomal suture in Hymenoptera. Can. J. Zool. 31:20-29.
Eickwort, G. C. 1963. Comparative morphology of New World genera of halictine bees (Hymenoptera: Halictidae). Unpublished M.S. thesis, Michigan State University, vi & 109 pp.
———. 1967. The status of *Pseudaugochloropsis nigerrima* in Costa Rica (Hymenoptera: Halictidae). J. Kansas Entomol. Soc. 40:232-237.
Eickwort, G. C., and R. L. Fischer. 1963. A morphological study of the tibial spurs of bees of the subfamily Halictinae (Hymenoptera: Halictidae) of eastern North America. Ann. Entomol. Soc. Amer. 56:348-354.
Fabricius, J. C. 1793. Entomologia Systematica. vol. 2. 519 pp.
———. 1804. Systema Piezatorum, 439 & 30 pp.
Friese, H. 1908. Die Apidae (Blumenwespen) von Argentina nach den Reisenergebnissen der Herren A. C. Jensen-Haarup und P. Jörgensen in den Jahren 1904-1907. Flora og Fauna (Silkeborg) 1908:1-94.
———. 1916a. Zur Bienenfauna von Costa Rica. (Hym.). Stettiner Entomol. Zeit. 77:287-348.
———. 1916b. Die *Halictus*-Arten von Chile. (Hym.). Deut. Entomol. Z. 1916:547-564.
———. 1921. Nachtrag zur Bienenfauna von Costa Rica. Stettiner Entomol. Zeit. 82:74-98.
———. 1924. Über die Urbienengattung Temnosoma Sm. Zool. Jahrbuch. abt. Syst. 49: 534-536.
———. 1925. Neue neotropische Bienenarten, zugleich II. Nachtrag zur Bienenfauna von Costa Rica (Hym.). Stettiner Entomol. Zeit. 86(2):1-41.
———. 1926. Die Nachtbienen-Gattung *Megalopta* Sm. Stettiner Entomol. Zeit. 87:111-135.
Herbst, P. 1917. Durchsicht der von Spinola in der von Claude Gay 1851 herausgegebenen Historia fisica y politica de Chile, Zoologia, Vol. VI beschriebenen *Apidae*, nebst einigen einleitenden Bemerkungen. Deut. Entomol. Z. 1917:257-294.
———. 1922. Revision der Halictus-Arten von Chile (Hym.). Entomol. Mitteilungen 11:180-191.
International Commission on Zoological Nomenclature. 1966. Opinion 788. *Megalopta* Smith, 1853 (Insecta, Hymenoptera): Designation of a type-species under the plenary powers. Bull. Zool. Nomenclature 23:211-212.
Jensen-Haarup, A. C. 1908. Biological researches amongst the Argentine bees with special reference to flowers they visit. Flora og Fauna (Silkeborg) 1908:95-107.
Krombein, K. V. 1958. Superfamily Apoidea, pp. 204-261 *in* Krombein, K. V., ed., Hymenoptera of America North of Mexico, Synoptic Catalog, first supplement. U.S. Dep. Agr. Monogr. 2. 305 pp.
———. 1967. Superfamily Apoidea, pp. 422-520 *in* Krombein, K. V., ed., Hymenoptera of

America North of Mexico, Synoptic Catalog, second supplement. U.S. Dep. Agr. Monogr. 2. 584 pp.

LINDAUER, M., and J. O. NEDEL. 1959. Ein Schweresinnesorgan der Honigbiene. Z. Vergleichende Physiol. 42:334-364.

MARKL, H. 1962. Borstenfelder an den Gelenken als Schweresinnesorgane bei Ameisen und anderen Hymenopteren. Z. Vergleichende Physiol. 45:475-569.

MARTIN, H., and M. LINDAUER. 1966. Sinnesphysiologische Leistungen beim Wabenbau der Honigbiene. Z. Vergleichende Physiol. 53:372-404.

MICHENER, C. D. 1944. Comparative external morphology, phylogeny and a classification of the bees. Bull. Amer. Mus. Natur. Histor. 82:157-326.

———. 1951. Family Halictidae, pp. 1104-1134 *in* Muesebeck, C. F. W., K. V. Krombein, H. K. Townes, eds., Hymenoptera of America North of Mexico, Synoptic Catalog. U.S. Dep. of Agr. Monogr. 2. 1420 pp.

———. 1954. Bees of Panamá. Bull. Amer. Mus. Natur. Histor. 104:1-175.

———. 1956. Hymenoptera, pp. 131-140 *in* Tuxen, S. L., ed., Taxonomist's Glossary of Genitalia in Insects. Ejnar Munksgaard, Copenhagen. 284 pp.

———. 1965. A classification of the bees of the Australian and South Pacific regions. Bull. Amer. Mus. Natur. Histor. 130:1-362, pls. 1-15.

MICHENER, C. D., and W. B. KERFOOT. 1967. Nests and social behavior of three species of *Pseudaugochloropsis* (Hymenoptera: Halictidae). J. Kansas Entomol. Soc. 40:214-232.

MICHENER, C. D., and J. S. MOURE. 1964. *Megalopta* Smith, 1853 (Insecta, Hymenoptera): proposed designation of a type-species under the plenary powers. Z.N.(S.) 1624. Bull. Zool. Nomenclature 21:148-149.

MICHENER, C. D., and R. R. SOKAL. 1966. Two tests of the hypothesis of nonspecificity in the *Hoplitis* complex (Hymenoptera: Megachilidae). Ann. Entomol. Soc. Amer. 59:1211-1217.

MITCHELL, T. B. 1960. Bees of the Eastern United States, vol. I. North Carolina Agr. Exp. Sta. Tech. Bull. 141. 538 pp.

MOURE, J. S. 1941a. I—Apoidea neotropica. Arq. Zool. Estado São Paulo 2:39-64.

———. 1941b. Apoidea neotropica—III. Arq. Mus. paranaense 1:41-99.

———. 1943. Notas sôbre abelhas da coleção Zikán (Hym. Apoidea). Rev. de Entomol. (Rio) 14:447-484.

———. 1944a. Notas sôbre abelhas da coleção Zikán. II. (Hym. Apoidea). Rev. de Entomol. (Rio) 15:273-291.

———. 1944b. Abelhas de Monte Alegre (Est. S. Paulo) *(Hym.-Apoidea)*. Papéis avulsos Dep. Zool. São Paulo 6:103-125.

———. 1947. Novos agrupamentos genéricos e algumas espécies novas de abelhas sulamericanas. Publ. avulsas Mus. paranaense no. 3, pp 1-37.

———. 1950. Halictidae novos da America do Sul (Hymenopt.-Apoidea). Dusenia 1:307-323.

———. 1951. *Ariphanarthra,* um novo genero de Halictidae. (Hymenopt.-Apoidea). Dusenia 2:137-140.

———. 1958a. *Augochlorodes,* a new genus of Halictinae from Brasil (Hymenoptera, Apoidea). J. Kansas Entomol. Soc. 31:53-55.

———. 1958b. On the species of Megalopta described by F. Smith (Hymenoptera, Apoidea). J. New York Entomol. Soc. 66:179-190.

———. 1960a. A review of the genus *Paroxystoglossa* (Hymenoptera: Halictidae). Univ. Kansas Sci. Bull. 40:121-133.

———. 1960b. Notes on the types of the Neotropical bees described by Fabricius (Hymenoptera: Apoidea). Studia Entomol. 3:97-160.

———. 1964. Two new genera of halictine bees from the Araucanian subregion of South America (Hymenoptera: Apoidea). J. Kansas Entomol. Soc. 37:265-275.

NEESE, V. 1965. Zur Funktion der Augenborsten bei der Honigbiene. Z. Vergleichende Physiol. 49:543-585.

ORDWAY, E. 1966. Systematics of the genus *Augochlorella* (Hymenoptera, Halictidae) north of Mexico. Univ. Kansas Sci. Bull. 46:509-624.

OGLOBLIN, A. A. 1953. Un nuevo Halictidae (Hym. Apodidae): un nuevo subgénero de Temnosoma. Bio. Soc. Entomol. Argentina 2:2-3.

———. 1954. Un nuevo subgenero de "Temnosoma" F. Smith (Halictidae, Hymenoptera). Neotropica 1:5-8.

Richards, A. G. 1952. Studies on arthropod cuticle. VIII. The antennal cuticle of honeybees, with particular reference to the sense plates. Biol. Bull. 103:201-225.

Richards, O. W. 1956. An interpretation of the ventral region of the hymenopterous thorax. Proc. Roy. Entomol. Soc. London (A) 31:99-104.

Sakagami, S. F., and C. D. Michener. 1962. The Nest Architecture of the Sweat Bees (Halictinae). Univ. Kansas Press. 135 pp.

Sakagami, S. F., and J. S. Moure. 1965. Cephalic polymorphism in some Neotropical halictine bees (Hymenoptera—Apoidea). Aca. Brasileira Cienc. 37:303-313.

——— and ———. 1967. Additional observations on the nesting habits of some Brazilian halictine bees (Hymenoptera, Apoidea). Mushi 40:119-138.

Sakagami, S. F., and F. L. Wain. 1966. *Halictus latisignatus* Cameron: a polymorphic Indian halictinae bee with caste differentiation (Hymenoptera, Halictidae). J. Bombay Natur. Histor. Soc. 63:57-73.

Sandhouse, G. A. 1937. The bees of the genera *Augochlora, Augochloropsis,* and *Augochlorella* (Hymenoptera; Apoidea) occurring in the United States. J. Washington Acad. Sci. 27: 65-79.

———. 1943. The type species of the genera and subgenera of bees. Proc. U.S. Nat. Mus. 92:519-619.

Say, T. 1837. Descriptions of new North American Hymenoptera, and observations on some already described (continuation). Boston J. Natur. Histor. 1:361-416.

Schrottky, C. 1902. Ensaio sobre as abelhas solitarias do Brasil. Rev. Mus. Paulista 5:330-613.

———. 1906. Neue und wenig bekannte südamerikanische Bienen. Z. Syst. Hymenopterologie Dipterologie 6:303-316.

———. 1909a. Nuevos Himenopteros sudamericanos. Rev. Mus. La Plata 16:137-149.

———. 1909b. Synonymische Bemerkungen über einige südamerikanische *Halictinae*. (Hym.). Deut. Entomol. Z. 1909:479-485.

———. 1910. Berichtigung. (Hym.). Deut. Entomol. Z. 1910:540.

———. 1911. Descripcão de abelhas novas do Brazil e de regiões visinhas. Rev. Mus. Paulista 8:71-88.

———. 1914. Einige neue Bienen aus Süd-Amerika. Deut. Entomol. Z. 1914:625-630.

Sichel, J. 1867. Hymenoptera Fossoria et Mellifera. Supplement (pp. 139-156) to H. de Saussure, Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857, 1858, 1859. Zoologischer Theil, vol. 2: Hymenoptera. Vienna. 156 pp., 4 pls.

Smith, F. 1853. Catalogue of Hymenopterous Insects in the Collection of the British Museum, part 1: Andrenidae and Apidae. London. 197 pp. 6 pls.

———. 1879. Descriptions of New Species of Hymenoptera in the Collection of the British Museum. London. 240 pp.

Snodgrass, R. E. 1941. The male genitalia of Hymenoptera. Smithsonian Misc. Collections 99(14):1-86, 33 pls.

———. 1956. Anatomy of the Honey Bee. Comstock Publ. Assoc., Ithaca, New York. xiv & 334 pp.

———. 1957. A revised interpretation of the external reproductive organs of male insects. Smithsonian Misc. Collections 135(6):1-60.

———. 1960. Facts and theories concerning the insect head. Smithsonian Misc. Collections 142(1):1-61.

Sokal, R. R., and C. D. Michener. 1967. The effects of different numerical techniques on the phenetic classification of bees of the *Hoplitis* complex (Megachilidae). Proc. Linnean Soc. London 178:59-74.

Sokal, R. R., and P. H. A. Sneath. 1963. Principles of Numerical Taxonomy. W. H. Freeman and Co., San Francisco. xvi & 359 pp.

Spinola, M. 1851. Himenopteros, pp. 153-569 *in* Gay, Claudio, ed., Historia fisica y politica de Chile, Zoologia, vol. 6, Paris. 572 pp.

Staveley, E. F. 1862. Notes on the form of the comb (pecten) in different Andrenidae and Apidae, and on the alar hooks of the species of Sphecodes and Halictus. Proc. Zool. Soc. London 1862:118-123.

STOCKHAMMER, K. A. 1966. Nesting habits and life cycle of a sweat bee, *Augochlora pura* (Hymenoptera: Halictidae). J. Kansas Entomol. Soc. 39:157-192.

STRAND, E. 1910. Beitrage zur Kenntnis der Hymenopterenfauna von Paraguay auf Grund der Sammlungen und Beobachtungen von Prof. J. D. Anisits. vii—Apidae. Zool. Jahrbuch abt. Syst. 29:455-562.

———. 1921. Apidologisches, insbesondere über paläarktische Andrena-Arten, auf Grund von Material des Deutschen Entomologischen Museums. Arch. Naturgeschichte abt. A, 87:266-304.

TIMBERLAKE, P. H. 1958. Temnosoma, a genus of bees new to the United States (Hymenoptera: Halictidae). Pan-Pacific Entomol. 34:34.

URBAN, D. 1963. Estudo comparativo da origem de alguns músculos cefálicos das abelhas (Hymenoptera-Apoidea). Bol. Univ. Paraná, Zool. 2:21-33.

VACHAL, J. 1903-1904a. Étude sur les Halictus d'Amérique (Hym.). Misc. Entomol. (Narbonne) 11:89-104, 121-136; 12:9-24, 113-128, 137-144.

———. 1904b. Halictus nouveaux ou présumés nouveaux d'Amérique (Hym.). Bul. Soc. Correze 26:469-486.

———. 1905. *Manuelia,* un nouveau genre d'Hyménoptères mellifères. Bul. Soc. Entomol. France 1905: 25-26.

———. 1911. Étude sur les Halictus d'Amérique (Hym.). Misc. Entomol. (Narbonne) 19:9-24, 41-56, 107-116.

WALTER, L. 1907. On the clasping organs attaching the hind to the fore wings in Hymenoptera. Smithsonian Misc. Collections 50:65-87, pls. VII-X.

APPENDIX 1. DESCRIPTIONS OF NEW SPECIES AND LECTOTYPE DESIGNATION

Corynurella mourei, new species

(Figs. 117, 184, 282, 335, 336)

Female. Length, 6.5 mm; wing length, 5 mm. Head about as wide as long, wider than mesosoma. Vertex produced above ocelli; gena about as wide as eye in lateral view. Clypeus and supraclypeal area slightly protuberant, each gently rounded, supraclypeal area below antennae longer than clypeus; clypeus projecting about half its length below lower margins of eyes. Frontal line weakly carinate, continued as impressed line to median ocellus. Lateral ocelli much nearer each other than to compound eyes; joined above by weakly impressed line. Compound eyes weakly emarginate, converging more below than above. Proboscidial fossa rather long, hypostomal l/w = 1.83; hypostomal bridge suture "open" nearly to posterior margin; c/l = .17; hypostomal carina not produced, anterior angle rounded; hypostoma widest near posterior flange; posterior flange rounded, slightly protruding beyond margin of occiput. Preoccipital ridge completely rounded; postgenal bridge suture "open" for about ¾ of its length. Measurements of head of holotype in mm: width, 1.72; length, 1.91; clypeal length, .385; lower interorbital distance, .78; upper interorbital distance, .98; clypeo-antennal distance, .41; interantennal distance, .15; antennocular distance, .30; antennocellar distance, .52; interocellar distance, .21; ocellocular distance, .29. Scape reaching to upper margin of median ocellus, length, .71; pedicel longer than wide, length .15; flagellomere 1 longer than wide, length .12; flagellomeres 2 and 3 wider than long, subequal, shorter than 1, length 2, .11; 3, .10; 4 about as long as wide, length, .14; flagellomeres then slightly increasing in length distally; 10 slightly longer than wide, length, .16; terminal flagellomere length, .30. Labrum with distal process medially narrow, expanded basally as two rounded lobes with fimbria on surface; labral teeth poorly defined distally, absent basally; distal keel normal, not flattened. Mouthparts p/M = .45, pw/pl = .17, pl/W = .87, gl/pl = .57, gl/W = .50; galeal comb of 9 or 10 teeth in specimen dissected. Median and parapsidal lines of mesoscutum weakly impressed. Median scutellar impression not evident. Basal area of propodeum slightly longer than scutellum and over twice as long as metanotum; propodeal triangle weakly impressed; lateral carinae of posterior surface of propodeum short, barely surpassing posterior submarginal

pits. Marginal cell of forewing extending nearly to apex of wing, mc/wl = .79. Submarginal cells 2 plus 3 subequal in length to 1 on lower margin; 2 not greatly narrowed anteriorly; cells 2 and 3 both receive a recurrent vein. Stigma very large, l/w = 2.30. About 5 hamuli (arranged 2-1-2) on hind wing. Front trochanter rather long and narrow, about 3 times longer than wide. Hind femur with lower surface slightly concave; scopa not dense. Basitibial plate well defined but rim not raised above surface of plate; plate smooth but not glossy; no setae on plate. Inner hind tibial spur with about 4 rounded teeth, decreasing in length apically. Pseudopygidial area of metasomal tergum V transparent, with few long setae.

Integument rather shiny and weakly punctured. Face closely but weakly and obscurely punctured, punctures less distinct below antennal sockets; supraclypeal area and clypeus polished; with scattered obscure punctures of medium depth, vertex polished, not punctate; gena shiny but obscurely roughened; postgena with close fine obscure longitudinal roughening, not shiny. Anterior surface of pronotum polished; lateral surface with poorly defined striae parallel to lateral ridge. Mesoscutum and scutellum polished, not punctured; metanotum with no evident punctures, slightly less polished. Mesepisternum and metepisternum polished, not punctured; pre-episternum shiny but slightly obscurely roughened; ventral surface of mesepisternum obscurely roughened. Basal area of propodeum shiny, with fine, close concentric striae not interrupted medially, anterior striae bow-shaped, posterior striae transverse; striae not reaching slightly raised polished rim of basal area; lateral and posterior surfaces polished, not punctured. Dorsum of metasoma shiny, punctures not evident, anterior surface of tergum I polished; venter of metasoma with obscure punctures bearing setae, less shiny.

Color generally testaceous, head and mesosoma largely suffused with dark metallic blue-green. Head blue-green; edge of clypeus, labrum and mandibles (except red-brown tips) testaceous. Scape yellow, clouded with brown on inner surface near apex; pedicel and flagellum dark brown, lighter beneath. Mesosoma blue-green, testaceous undertones more evident on pleura and venter; pronotal lobe testaceous; tegula yellowish-hyaline; wing membrane clear; veins and stigma brown; legs yellowish-testaceous; upper surface of hind tibia slightly infuscated. Metasomal segments I to III testaceous; rest of metasoma dark brown; extent of brown pigmentation variable, sometimes darkening most of segments II and III.

Pubescence of head sparse, pale; gena behind eye and parocular area from epistomal lobe to notch of eye with short, appressed, distinctly plumose, white setae, not obscuring surface. Pubescence of dorsum of mesosoma pale, not dense nor obscuring surface, setae longest on scutellum and metanotum, absent or basal area of propodeum; dense fringe of white setae covering first thoracic spiracle, on edge of pronotal lobe; pubescence of mesepisternum white, densest on venter and near pre-episternal sulcus, not obscuring surface; pubescence on lateral and posterior surfaces of propodeum pale, long, weakly plumose, not dense. Leg setae pale to testaceous, more reddish on tibiae and tarsi, not dense or especially long. Pubescence of dorsum of metasoma pale, sparse, not appressed, long and erect on anterior surface of tergum I; fimbria of terga V and VI denser, golden; postgradular areas of sterna with long erect pale setae distally.

Male. Length, about 7 mm; wing length, 4.5 mm. Head longer than wide, about as wide as mesosoma; gena narrower than eye in lateral view; supraclypeal area below antennae slightly shorter than clypeus; eyes slightly more deeply emarginate than in female, converging more strongly below; frontal line more weakly defined; median impressed line to median ocellus very weakly defined; line not impressed behind lateral ocelli. Measurements of head of allotype in mm: width, 1.47; length, 1.76; clypeal length, .43; lower interorbital distance, .54; upper interorbital distance, .83; clypeo-antennal distance, .36; interantennal distance, .17; antennocular distance, .21; antennocellar distance, .50; interocellar distance, .18; ocellocular distance, .26. Agrees with description of female except for usual sexual differences and as follows: scape slightly shorter, length, .51; pedicel shorter, about as wide as long, length, .15; flagellomere 1 slightly longer than wide, length, .15; 2 subequal in length to 1 but shorter than 3, length, .15; 3 length, .20; flagellomeres slightly increasing in length distally, 10 about 2/3 as wide as long, length, .22; terminal flagellomere length, .30. Distal process of labrum hidden by mandibles; basal area with prominent setae below bevel of basal elevation. Metasoma rather narrow and elongate; sterna VII and VIII illustrated in Fig. 282; genitalia illustrated in Figs. 335 and 336.

Punctation generally weaker than in female; postgenal roughening not defined, shiny; lateral surface of pronotum without striae; basal area of propodeum with striae more weakly defined, only extending about half the length of propodeum along midline, rim of basal area glossy, wide.

Color more yellowish-testaceous; dark blue-green tints generally less intense; lower half of clypeus, labrum, and mandibles (except reddish tip) yellow-testaceous; scape translucent-yellowish, dusky distally; metasomal terga V and VI partly testaceous, brown pigmentation of metasoma not as dark. Pubescence generally similar to that of female except for usual sexual differences.

Type material. Holotype female, allotype male, and 2 paratype females, Brasil, Rio de Janeiro, Baia de Guanabara, Floresta dos Macacos, April 1961 (M. Alvarenga); 3 paratype females, same data, 16 February 1961; 2 paratype females, Floresta de Tijuca, Brasil, 23 February 1953, C. A. C. Seabra coll.; 1 paratype female, same data, 7 February 1953. Holotype and allotype in the Snow Entomological Museum of The University of Kansas; paratype females in that collection, the collection of Pe. J. S. Moure (Universidade do Paraná, Brasil), and the collection of Dr. C. A. C. Seabra (Rio de Janeiro, Brasil).

This species is named in honor of Pe. J. S. Moure, C. M. F., of the Universidade do Paraná, Brasil, in recognition of the aid he has given me in this study and of the contributions he has made to the study of South American bees.

Corynurella mourei is readily distinguished by its largely testaceous coloration, elongate marginal cell and large stigma of the forewings, and unusual pronotal structure. A macrocephalic female of this or a closely-related species from Yurac, 67 mi. E. of Tingo Maria, Peru, 11 December 1954, E. I. Schlinger and E. S. Ross, colls., is in the collection of the California Academy of Sciences, San Francisco.

Andinaugochlora micheneri, new species

(Figs. 121, 148, 203, 212, 241, 290-292, 358-361)

Female. Length, 9.0 to 9.5 mm; wing length 7.5 mm. Head wider than long, about as wide as mesosoma; gena about as wide as eye in lateral view. Supraclypeal area protuberant, rather abruptly beveled; clypeus protuberant and rounded; clypeus and supraclypeal area below antennae subequal in length; clypeus projecting over half its length below lower margins of eyes. Frontal line weakly carinate, not extending as impressed line to median ocellus; no impressed line behind lateral ocelli. Compound eyes strongly emarginate, converging about equally below and above. Proboscidial fossa rather long, hypostomal l/w = 1.49; hypostomal bridge suture closed about half its length, c/l = .43; hypostomal carina not produced, anterior angle rounded; fossa widest near posterior flange; posterior flange truncate, projecting beyond margin of occiput. Preoccipital ridge weakly carinate laterally and dorsally, not carinate near junction with hypostomal carina; postgenal bridge suture open for about half of its length. Measurements of head of holotype in mm: width, 2.63; length, 2.30; clypeal length, .59; lower interorbital distance, 1.38; upper interorbital distance, 1.49; clypeo-antennal distance, .50; interantennal distance, .25; antennocular distance, .58; antennocellar distance, .70; interocellar distance, .30; ocellocular distance, .28. Scape reaching to level of top of lateral ocelli, length, 1.10; pedicel slightly longer than wide, length, .20; flagellomere 1 subequal to pedicel, longer than wide, length, .20; 2 wider than long, length, .15; 3 as long as wide, length, .17; flagellomeres slightly increasing in length distally, 10 about as long as wide, length, .23; length terminal flagellomere, .34. Labrum illustrated in Fig. 148. Mouthparts p/M = .33; pl/W = .70; pw/pl = .18, gl/pl = .52; gl/W = .36; galeal comb of 3 to 5 short teeth. Mesoscutal lip rather high and narrow, but rounded and not strongly projecting over pronotum; median line and parapsidal lines moderately impressed. Scutellum not impressed medially; basal area of propodeum subequal in length to metanotum; metanotum about two-thirds as long as scutellum; propodeal triangle clearly indicated; lateral carinae of posterior surface of propodeum diverging, extending slightly less than halfway to basal area. Submarginal cells 2 plus 3 of forewing subequal in length to 1; 2 rather narrow and receiving first recurrent near apex or interstitial with 2nd transverse cubital; about 8 hamuli (arranged

4-1-3) on hind wing. Hind femur not concave on lower surface, scopa moderately dense; inner hind tibial spur with about 3 teeth (Fig. 212); basitibial plate as in Fig. 203.

Integument not at all shiny; face above antennal sockets and vertex closely and densely punctate, punctures contiguous; parocular area below antennae with obscure punctures, surface finely granular; supraclypeal area above level with rather close and obscure punctures; below bevel and upper portion of clypeus with finely granular surface and weak, widely spaced punctures, not shiny; clypeus below bevel not granular, with coarser obscure punctures. Gena obscurely roughened above, finely and closely striate below, behind lower portion of eye; postgena very finely granular, not shiny or striate. Dorsal surface of pronotum directly behind pronotal lip smooth, polished bordering mesoscutal lip, pronotum otherwise smooth or obscurely roughened and not shiny. Mesoscutal punctures distinct but rather fine, slightly smaller than punctures on vertex, contiguous over most of mesoscutum, somewhat obscure near anterior-lateral angles, slightly more separated in central area of mesoscutum, there rarely separated by more than their diameter. Scutellar punctures slightly coarser, not contiguous but separated by less than their diameter; metanotal punctures fine and close, not well defined. Pre-episternum obscurely roughened, slightly shiny; mesepisternum and upper portion of metepisternum transversely striate; ventral surface of mesepisternum obscurely roughened, lower portion of metepisternum finely granular. Basal area of propodeum finely granular, with light obscure basal striations, not reaching posterior margin; lateral and posterior surfaces obscurely roughened or finely granular. Dorsum of metasoma smooth or slightly roughened but not shiny, basal zones of terga and anterior surface of tergum I with fine close punctures or lightly and obscurely roughened; posterior marginal areas depressed and smooth. Venter with punctures bearing setae; posterior marginal areas depressed and smooth.

Integument green with cupreous areas, these areas occasionally partially yellowish or green. Face cupreous with vertex and frons greenish; gena and postgena green with golden or cupreous tints; apical half of clypeus, labrum, and mandible (except red-brown tip) dark brown; scape and upper surface of flagellum dark brown; lower surface of flagellum ferruginous. Central area of mesoscutum, between parapsidal lines, cupreous, color sharply delimited from green to cupreous-green of remainder of mesosoma; shiny dorsal surface of pronotum cupreous. Tegulae dark brown, anterior outer edge hyaline, anterior inner edge green; wing slightly infuscated, veins and stigma medium brown; vein R dark brown. Coxae, trochanters, femora, front tibiae dark brown with green tints, rest of legs fuscous. Dorsum of metasoma, including posterior marginal areas, green, often slightly yellowish or purplish; extreme posterior edges of terga brownish; venter dull brownish-green; posterior marginal areas and sternum VI brown.

Pubescence of head long, plumose, and erect; on face pale with some dark setae interspersed; on frons and vertex, dark; on genae and post-genae, pale. Mesoscutum with very short dense pubescence, obscuring most of surface, few longer setae intermixed; most of central cupreous area overlaid with dark brown pubescence, contrasting strongly with white lateral pubescence; zone of white pubescence extending narrowly across posterior margin of mesoscutum; setae longer and yellowish on anterior-lateral angle of mesoscutum; scutellum with similar dense, short, dark brown pubescence, laterally with some longer pale setae; metanotum with short, dense, white pubescence, longer golden setae intermixed; laterally with longer pale setae. Dorsal surface of pronotum behind pronotal lip with dense, short, pale setae; pronotum otherwise with scattered pale setae; first thoracic spiracle covered by dense fringe of white setae, on edge of pronotal lobe. Mesepisternum laterally and metepisternum bare, scattered pale setae on venter of mesepisternum. Basal area of propodeum bare; upper edge of lateral surface with zone of rather thick pale plumose setae of moderate length; lateral surface with very short fine setae and scattered long setae; posterior surface with moderately long, plumose, erect setae. Pubescence of coxae, trochanters, and femora pale, long on ventral surface of front femur; mesofemoral brush golden; pale yellowish hairs on ventral surfaces of tibiae, brown on dorsal surfaces, pubescence dense on hind tibia and apex of dorsal surface of middle tibia; mesotibial comb golden; pubescence of anterior surfaces of basitarsi brown, of posterior surfaces golden; of remainder of tarsi ferruginous; penicillus ferruginous. Pubescence of anterior surface of metasomal tergum I pale, erect, moderately long; of dorsal

surface of tergum I and terga II to IV very short, pale, inconspicuous, slightly longer laterally; prepygidial and pygidial fimbria fuscous-ferruginous; pubescence of venter moderately long and dense, pale, weakly plumose; on sternum V somewhat yellowish; slightly ferruginous on VI.

Male. Length, about 9 mm; wing length, 7.5 mm. Head about as wide as long, about as wide as mesosoma; clypeus much longer than supraclypeal area below antennae; eyes more deeply emarginate than in female, converging more strongly below. Hypostomal bridge suture closed just at flange. Measurements of head of allotype in mm: width, 2.36; length, 2.24; clypeal length, .59; lower interorbital distance, .99; upper interorbital distance, 1.38; clypeoantennal distance, .37; interantennal distance, .36; antennocular distance, .35; antennocellar distance, .62; interocellar distance, .28; ocellocular distance, .28. Agrees with description of female except for usual sexual differences and as follows: antenna very long, surpassing propodeum; scape shorter, not reaching median ocellus, length, .63; pedicel about as wide as long, length, .14; flagellomere 1 length, .17; flagellomere 2 much longer than 1, longer than wide, length, .33; flagellomeres increasing in length apically, length 3, .37; length 10, .47; terminal flagellomere length, .57; plate areas present. Metasoma narrow and elongate, sterna IV and V with posterior margins slightly concave medially, central areas slightly depressed; sternum VI as in Fig. 241; hidden sterna and genitalia as illustrated in Figs. 290-292, 358-361.

Gena not striate; postgena obscurely roughened. Scutellar punctures more widely spaced than in female, frequently more than a diameter apart, closer along midline and near edges; scutellum somewhat shiny; mesepisternum and metepisternum obscurely roughened or with very obscure punctures, somewhat shiny near middle coxa; no striae except near top of metepisternum, where poorly defined. Basal area of propodeum slightly shiny at posterior margin; posterior and lateral surfaces of propodeum with obscurely defined punctures or obscurely roughened.

Integument without cupreous areas; head green with yellowish tints; postgena near anterior angle of hypostomal carina dark purplish-brown; clypeus entirely green except for posterior margin, margin of clypeus, labrum and mandible (except reddish tip) dark brown. Scape green; pedicel and upper surface of flagellum dark brown; lower surface yellowish, color sharply delimited posteriorly. Mesosoma green with yellowish tints; legs green except dark brown tarsi. Metasoma dorsally blue-green, with violet highlights; extreme posterior edges of terga brownish.

Pubescence of head longer than in female; mesosoma without areas of short dense pubescence; pubescence of dorsum long, plumose, not dense, brown medially and pale laterally; mesepisternum with rather long, pale brownish, plumose pubescence. Pubescence of legs much sparser, generally paler. Tergal pubescence pale and sparse, but longer and more evident than that of female.

Type material. All from Ecuador. Holotype female, allotype male, and 37 female, 44 male paratypes, Oriente-Ambato, 2600 m, October 1956; 1 paratype male, same data, December 1956; 2 paratype females, Cotocallao, October 1950; 1 paratype female, Cotocallao, Pichincha Prov., 27 April 1958, 10,000 ft. elev., R. W. Hodges, coll.; 8 paratype females, Quito, Pichincha, 15 January 1958, R. W. Hodges, coll.; 1 paratype female, 5 mi. S of Latacunga, Cotopaxi, 2800 m, 7 February 1955, E. I. Schlinger and E. S. Ross, colls.; 1 paratype male, 7 mi. S Cayambe, Pichincha, 2740 m, 27 February 1955, E. I. Schlinger and E. S. Ross, colls. Holotype and allotype in the Snow Entomological Museum of The University of Kansas, paratypes in that collection, the Michigan State University entomological museum, the California Academy of Science, the United States National Museum, and the collection of Pe. J. S. Moure (Universidade do Paraná, Brasil).

This species is named in honor of Dr. C. D. Michener of The University of Kansas, in recognition of the guidance given me throughout this study and of the contributions he has made to the study of halictine systematics and biology.

The female of *Andinaugochlora micheneri* can be distinguished from related undescribed species by the unusual dorsal pattern of pubescence and coloration of the mesosoma and the striate bare episterna. The males can be distinguished from *Neocorynura* by the modifications of the sixth metasomal sternum and from related species by the bluish metasoma, green head and mesosoma, and dark tarsi.

Augochloropsis (Paraugochloropsis) metallica (Strand)

NEW COMBINATION, preoccupied. [Probable junior synonym of *Augochloropsis argentina* (Friese)]

Rivalisia metallica Strand, 1921. Arch. Naturgeschichte, Abt. A, 87:270. (Preoccupied in *Augochloropsis* by *metallica* (Fabricius), 1793, Entomologia Systematica 2:209.7, published as *Andrena metallica*.)

With the kind help of Dr. J. Oehlke, I have been able to examine the two male cotypes of *Rivalisia metallica* Strand from the Deutsches Entomologisches Institut (Eberswalde, East Germany) and place that species in *Augochloropsis (Paraugochloropsis)*. As neither Strand (1921) nor Blüthgen (1928) designated which specimen was to be considered the holotype of *metallica*, I hereby designate the specimen labeled "Usambara, A. Heyne, Berlin-Wilm., coll. Kraatz, Rivalisia metallica m., Strand det., paratypus," as hololectotype and have so labeled it. The genitalia of this specimen had been dissected and glued to a paper triangle pinned with the specimen. The second specimen, similarly labeled except that "typus" replaces "paratypus" is hereby designated a paralectotype and is so labeled. While Strand obviously had intended the latter specimen to be the type specimen of his species, its head is now missing, so I prefer to select the more nearly intact specimen. The genitalia of the paralectotype are not dissected.

In my opinion, the specimens are conspecific. They very closely resemble a specimen (which I have labeled as a homotype of *metallica* Strand) in the Snow Entomological Museum of The University of Kansas identified by Moure as *Augochloropsis argentina* (Friese), 1908, a common species in Argentina (Jensen-Haarup, 1908) and Brazil (Moure, 1944a). However, I prefer not to place *metallica* Strand into synonymy until types or homotypes of *argentina* and related species can be compared. I have no doubt that the specimens of *metallica* Strand are mislabeled as being from Africa and are in reality from South America, most likely from the region of southern Brazil to Argentina.

APPENDIX 2. ALPHABETICAL LIST OF GENERIC NAMES IN THE AUGOCHLORINI

Andinaugochlora n. g.
Ariphanarthra Moure
Augochlora Smith
Augochlorella Sandhouse
Augochlorodes Moure
Augochloropsis Cockerell

(*Cacosoma* Smith)=*Neocorynura (Neocorynura)* Schrottky
Caenaugochlora Michener
Callochlora Moure (subgenus of *Corynura* Spinola)
Ceratalictus Moure
Chlerogas Vachal
Chlerogella Michener
Corynura Spinola
Corynurella n. g.
(*Corynogaster* Sichel)=*Corynura (Corynura)* Spinola
(*Corynuroides* Sandhouse)=*Rhinocorynura* Schrottky
(*Corynuropsis* Cockerell)=*Rhinocorynura* Schrottky
Ctenaugochlora n. subg. (subgenus of *Caenaugochlora* Michener)
(*Ctenocorynura* Schrottky)=*Rhinocorynura* Schrottky

(*Glyptobasia* Moure)=*Augochloropsis (Paraugochloropsis)* Schrottky
(*Glyptobasis* Moure)=*Augochloropsis (Paraugochloropsis)* Schrottky
(*Glyptochlora* Moure)=*Augochloropsis (Paraugochloropsis)* Schrottky

Halictillus Moure

Megalopta Smith
(*Megaloptella* Schrottky)=*Megalopta* Smith
Megaloptidia Cockerell
Megaloptina n. subg. (subgenus of *Megommation* Moure)
Megommation Moure
(*Micraugochlora* Schrottky)=*Temnosoma* Smith
Mycterochlora n. subg. (subgenus of *Augochlora* Smith)

Neocorynura Schrottky
Neocorynuroides n. subg. (subgenus of *Neocorynura* Schrottky)

(*Odontochlora* Schrottky)=*Augochlora (Augochlora)* Smith
(*Oxystoglossa* Smith)=*Augochlora (Augochlora)* Smith
Oxystoglossella n. subg. (subgenus of *Augochlora* Smith)
(*Oxystoglossidia* Moure)=*Augochlorella* Sandhouse

(*Paraugochlora* Schrottky)=*Augochloropsis (Paraugochloropsis)* Schrottky
Paraugochloropsis Schrottky (subgenus of *Augochloropsis* Cockerell)
Paroxystoglossa Moure
Pereirapis Moure
(*Pseudaugochlora* Michener)=*Pseudaugochloropsis* Schrottky
Pseudaugochloropsis Schrottky

Rhectomia Moure
Rhinocorynura Schrottky
(*Rhopalictus* Sichel)=*Corynura (Corynura)* Spinola
(*Rivalisia* Strand)=*Augochloropsis (Paraugochloropsis)* Schrottky

Temnosoma Smith
(*Temnosomula* Ogloblin)=*Temnosoma* Smith
(*Tetrachlora* Schrottky)=*Augochloropsis (Paraugochloropsis)* Schrottky
Thectochlora Moure
(*Tmetocoelia* Moure)=*Megalopta* Smith

APPENDIX 3. PORTIONS OF NUMERICAL ANALYSIS OF AUGOCHLORINE GENERA

TABLE 2. Coding of character states for numerical analysis of augochlorine genera.

Character	States
angle of epistomal sulcus	(1) obtuse, (2) right, (3) acute
clypeus	(1) protuberant, (2) normally beveled, (3) flattened, (4) projecting beyond posterior margin
clypeal tooth	(1) normal, (2) prolonged
clypeal modifications	(1) normal, (2) tuberculate or spined
frontal line	(1) normal, (2) enlarged basally
malar area	(1) normal, (2) elongate
preoccipital ridge	(1) rounded, (2) rounded or sharply angled, (3) sharply angled or carinate, (4) carinate, (5) lamellate
vertex	(1) normal, (2) enlarged behind ocelli
hypostomal l/w	(1) over 1.75, (2) 1.50 to 1.75, (3) 1.00 to 1.50, (4) less than 1.00
hypostomal bridge suture c/l	(1) over .75, (2) .50 to .75, (3) less than .50
hypostomal carina	(1) normal, (2) posterior flange projecting
hypostomal carina	(1) normal, (2) anterior angle right angle or projecting
compound eye w/l	(1) less than .100, (2) .100 to .135, (3) over .135

Character	States
eye hair	(1) normal, (2) long
ocelli	(1) normal, (2) enlarged
labral distal process	(1) narrowly triangular, (2) broadly triangular, (3) expanded and narrowed apically, (4) expanded and rounded, (5) expanded and truncate
labral distal keel	(1) present, (2) absent
labral basal elevation	(1) oval, (2) orbicular, (3) transverse
labral basal elevation	(1) low, (2) strongly protuberant, rounded, (3) anterior surface flattened, (4) notched, (5) bituberculate
labral fimbria	(1) long, on margin, (2) short, on surface
mandibular tooth	(1) absent, (2) normal, (3) enlarged supplementary teeth may be present
mandibular width	(1) normal, (2) broadened
maxillary anterior conjunctival thickenings	(1) normal, (2) joining distally
apex of galea	(1) lobed (normal), (2) pointed
inner strip of galea	(1) broad markings, (2) narrow markings, (3) long setae on strip
galeal comb	(1) absent, (2) weakly formed, (3) well formed
maxillary palpus p/M	(1) less than .4, (2) over .4, (3) greatly elongate
prementum anterior surface	(1) transparent, (2) normal, (3) flattened, no premental thickenings
prementum width, pw/pl	(1) over .20, (2) .13 to .19, (3) .06 to .12, (4) less than .05
salivary plate	(1) normal, (2) normal or well-defined, (3) well-defined
glossal length, gl/W	(1) less than .25, (2) .25 to .40, (3) over .40
labial palpal segments 2 + 3	(1) longer than 1, (2) shorter than 1
pronotum dorsally	(1) concave, (2) convex
pronotal lateral angle	(1) rounded, nearly absent, (2) obtuse, (3) produced, acute or rounded, (4) carinate anteriorly, (5) produced above dorsal ridge
pronotal dorsal ridge	(1) rounded, (2) carinate or sharply angled, (3) lamellate
pronotal lateral ridge	(1) rounded, (2) rounded or sharply angled, (3) sharply angled, (4) sharply angled or carinate, (5) carinate, (6) lamellate
mesoscutum	(1) normal, (2) narrowed anteriorly
mesoscutal lip	(1) nearly absent, (2) rounded, (3) sharply angled and projecting forwards, (4) lamellate or carinate
tegula	(1) normal, (2) strongly pitted, (3) produced
basal area of propodeum	(1) smooth, (2) weakly striate or smooth, (3) striate
posterior surface of propodeum	(1) narrow, (2) normal, (3) broad
propodeal pit	(1) normal, (2) enclosed in notch
apex of marginal cell	(1) acute or narrowly truncate, (2) truncate and usually appendiculate
marginal cell mc/wl	(1) less than .65, (2) over .65
distal hamuli	(1) normal, (2) continuous row
inner hind tibial spur	(1) serrate, as in outer spur, (2) rounded serrations, (3) serrate to pectinate, (4) short-pectinate, (5) pectinate, (6) lamellate
scopa	(1) present, (2) absent
basitibial plate	(1) absent, (2) short, (3) normal
rim of basitibial plate	(1) raised rim, (2) normal, (3) obsolescent anteriorly
apex of basitibial plate	(1) broadly rounded, (2) narrowly rounded, (3) one edge defined only
anterior basitarsal brush	(1) weak or absent, (2) strong
pseudopygidial area	(1) absent, (2) normal, (3) scaled
tergum VI	(1) normal, (2) gradulus absent
sternum I	(1) normal, (2) spined or tuberculate
sterna IV-V	(1) resemble male, (2) with graduli, (3) without graduli

Character	States
antennal flagellomeres 2/1	(1) less than .85, (2) 1.00 to 1.50, (3) over 1.50
antennal length sc/2	(1) over 3, (2) 1 to 3, (3) less than 1
antennal modifications	(1) normal, (2) hooked, (3) projections on scape and pedicel
antennal plate areas	(1) absent, (2) present or absent, (3) present
labral distal process	(1) short or absent, (2) triangular, (3) expanded and rounded, (4) expanded and truncate
basal elevation of labrum	(1) extends across basal area, (2) notched, (3) not extending across basal area
inner hind tibial spur	(1) normal, (2) knobbed, (3) pectinate
patches of pubescence	(1) normal, (2) on propodeum, (3) on legs
metasoma	(1) petiolate, (2) elongate, (3) oval or elongate, (4) oval
tergum VII	(1) elongate, (2) gradually convex, (3) abruptly convex
gradulus of tergum VII	(1) absent or poorly defined, (2) present, well-defined
postanal filaments	(1) absent, (2) short or absent, (3) long
proctiger	(1) normal, (2) fringed with microtrichia
sternum III	(1) normal, (2) apex modified
sternum IV	(1) normal, (2) median setal clumps, (3) median tubercles or ridges
sternum IV	(1) normal, (2) lateral setal clumps, (3) lateral projections
posterior margin of sternum IV	(1) normal, (2) produced, (3) bilobed
sternum V	(1) normal, (2) median setal clumps, (3) median tubercles or ridges
sternum VI	(1) weakly notched, (2) strongly notched, (3) with depressions or median ridge, (4) flanged
apodemes of sternum VI	(1) normal, (2) narrow
posterior margin sternum VII	(1) membranous, (2) not produced, (3) median projection, (4) bilobed
sternum VII	(1) normal, (2) spiculum-like apodeme
posterior margin sternum VIII	(1) not produced, (2) median projection
junction sterna VII and VIII	(1) beyond apodemes, (2) at apodemes
spiculum of sternum VIII	(1) narrow, (2) broad
ventral bridge of gonobase	(1) membranous or narrow, (2) broad
dorsal lobes of gonobase	(1) slight, (2) strong and rounded, (3) strong and sharply angled
lateral ridge of ventral gonostylus	(1) not produced, (2) produced, (3) produced and lobed
lateral ridge of ventral gonostylus	(1) without setae, (2) with setae
basal process of ventral gonostylus	(1) present, (2) absent
parapenial lobe	(1) present, (2) absent
dorsal gonostylus	(1) absent or ridge, (2) membranous small area, (3) linear flap, (4) expanded shield
ventral gonostylus	(1) lobe narrowed basally, flattened surface with setae, (2) lobe produced from apex, (3) lobe broadly joining inner edge of gonocoxite
venter of penis valve	(1) ventral prong, (2) ventral keel, (3) unmodified
dorsum of penis valve	(1) dorsal ridge, (2) dorsal crest, (3) unmodified
dorsal depression of penis valve	(1) present, (2) absent
penis valve	(1) narrow, (2) usually expanded
volsella	(1) small, (2) normal, (3) enlarged
volsella inner margin	(1) notched medially, (2) not notched
color	(1) orange with green reflections, (2) bright green, blue, or red, (3) largely dark with green tints, (4) brown or dull metallic, (5) dull metallic, (6) orange with dull green reflections
average size	(1) small, (2) medium, (3) large
macrocephalic individuals	(1) never present, (2) sometimes present

Table 3. Coding of augochlorine genera and subgenera for numerical analysis.

Code	Taxon	Code	Taxon
1	Megaloptidia	17	Augochlora s. s.
2	Megommation s. s.	18	Oxystoglossella
3	Megaloptina	19	Mycterochlora
4	Ariphanarthra	20	Megalopta
5	Thectochlora	21	Caenaugochlora s. s.
6	Rhectomia	22	Ctenaugochlora
7	Corynurella	23	Pseudaugochloropsis
8	Rhinocorynura	24	Neocorynura s. s.
9	Corynura s. s.	25	Neocorynuroides
10	Callochlora	26	Temnosoma
11	Halictillus	27	Paroxystoglossa
12	Chlerogas	28	Andinaugochlora
13	Chlerogella	29	Augochloropsis s. s.
14	Ceratalictus	30	Paraugochloropsis
15	Pereirapis	31	Augochlorodes
16	Augochlorella		

TABLE 4. Matrix of Correlation Coefficients among Augochlorine Genera and Subgenera *(Upper Right)*
TABLE 5. Matrix of Distance Coefficients among Augochlorine Genera and Subgenera *(Lower Left)*

O.T.U.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
1.	xxx	.74	.55	.67	−.07	−.19	−.16	−.08	−.18	−.26	−.27	−.13	.09	−.19	−.19	.02	−.03	−.05	−.12	.08	−.06	−.04	.04	−.23	−.33	−.19	−.17	−.37	−.27	−.23	−.22
2.	0.82	xxx	.78	.57	−.10	−.22	−.15	−.11	−.29	−.31	−.30	−.02	.03	−.19	−.24	−.06	−.11	−.13	−.18	.08	−.18	−.13	.12	−.34	−.33	−.07	−.19	−.22	−.06	−.01	.05
3.	1.04	0.71	xxx	.54	−.08	−.16	−.16	−.09	−.26	−.23	−.20	−.10	.04	−.13	−.18	−.06	−.13	−.16	−.20	.01	−.19	−.15	.19	−.30	−.31	−.06	−.22	−.12	−.09	−.05	−.03
4.	0.89	0.99	0.98	xxx	−.04	−.17	−.04	−.08	−.30	−.29	−.26	.01	.12	−.10	−.18	−.02	−.09	−.11	−.14	.05	−.13	−.07	.16	−.28	−.33	−.13	−.22	−.14	−.16	−.13	−.06
5.	1.42	1.40	1.32	1.30	xxx	.13	−.19	.07	−.10	−.01	.05	−.19	−.27	.27	.02	.06	−.22	−.20	−.20	−.06	.02	.05	−.05	−.05	.06	−.10	.21	.03	.12	.12	.11
6.	1.63	1.68	1.55	1.57	1.14	xxx	.53	.39	.33	.09	.34	−.35	−.09	−.05	−.20	−.29	−.27	−.31	−.23	−.01	−.22	−.07	−.24	.20	.10	−.10	.11	−.22	−.11	−.07	.10
7.	1.56	1.57	1.51	1.43	1.33	0.94	xxx	.44	.09	.00	.15	−.09	.28	−.17	.02	−.11	−.07	−.08	−.22	.05	−.08	−.01	−.17	.04	−.06	−.09	−.13	−.11	−.19	−.20	.02
8.	1.68	1.66	1.60	1.59	1.34	1.29	1.12	xxx	.17	.06	.12	−.15	−.09	−.09	−.14	−.24	−.15	−.19	−.14	−.01	−.18	−.15	−.23	.03	−.03	.01	−.06	−.21	−.04	−.03	−.14
9.	1.53	1.58	1.50	1.52	1.20	1.03	1.23	1.31	xxx	.77	.70	.00	.07	−.03	−.08	−.23	−.15	−.15	−.24	−.22	−.21	−.19	.23	.07	−.05	−.08	.21	−.22	−.19	.05
10.	1.68	1.66	1.55	1.59	1.23	1.30	1.35	1.43	0.63	xxx	.58	−.02	−.11	.08	−.02	−.15	−.15	−.14	−.12	−.23	−.05	−.17	−.15	.13	.03	.03	−.12	.23	−.17	−.17	.05
11.	1.64	1.65	1.53	1.57	1.18	1.09	1.24	1.39	0.71	0.87	xxx	.02	.12	−.19	−.13	−.31	−.21	−.22	−.24	−.27	−.17	−.08	−.18	.25	.15	−.12	−.04	.27	−.04	−.13	.16
12.	1.60	1.49	1.47	1.42	1.48	1.70	1.56	1.58	1.40	1.47	1.45	xxx	.44	−.17	−.02	−.10	−.28	−.28	−.24	−.16	.00	.01	.03	.13	.02	.01	−.03	.26	.02	.00	.17
13.	1.63	1.70	1.60	1.50	1.65	1.65	1.38	1.94	1.41	1.67	1.46	1.43	xxx	−.03	−.13	−.17	−.14	−.15	−.19	.08	−.10	−.14	−.03	−.14	−.20	.10	−.21	−.05	−.29	−.26	.01
14.	1.38	1.42	1.32	1.29	0.86	1.15	1.28	1.41	1.12	1.16	1.28	1.41	1.52	xxx	.45	.56	.05	.09	−.05	−.10	−.07	−.02	−.07	.02	.11	.03	.13	.03	−.14	−.18	−.15
15.	1.41	1.45	1.34	1.34	1.00	1.23	1.19	1.44	1.15	1.21	1.25	1.34	1.45	0.69	xxx	.43	.19	.22	.11	−.18	.07	−.06	−.04	.08	.12	−.13	−.06	−.08	−.11	−.14	−.02
16.	1.28	1.31	1.24	1.22	0.94	1.18	1.21	1.44	1.17	1.23	1.29	1.36	1.40	0.60	0.68	xxx	.18	.23	.15	−.05	.09	.03	−.02	−.11	.07	−.06	.09	.01	−.18	−.18	−.03
17.	1.55	1.55	1.52	1.49	1.38	1.66	1.43	1.61	1.40	1.47	1.51	1.56	1.89	1.20	1.12	1.09	xxx	.88	.67	−.09	.05	−.01	−.03	−.08	.03	−.17	−.16	−.16	−.12	−.11	−.24
18.	1.50	1.51	1.47	1.44	1.29	1.57	1.37	1.58	1.34	1.40	1.45	1.57	1.77	1.10	1.03	0.99	0.47	xxx	.53	−.06	.10	.04	.00	−.05	−.03	−.10	−.15	−.11	−.13	−.13	−.23
19.	1.58	1.60	1.56	1.52	1.36	1.52	1.52	1.60	1.40	1.45	1.52	1.61	1.82	1.19	1.16	1.10	0.80	0.92	xxx	−.05	.11	.13	.00	−.11	−.01	−.10	.04	−.09	.01	−.02	−.19
20.	1.77	1.65	1.68	1.68	1.63	1.77	1.62	1.74	1.78	1.81	1.84	1.91	1.97	1.66	1.69	1.58	1.75	1.68	1.71	xxx	.00	−.13	.11	−.16	−.01	−.06	.03	−.06	.01	.01	−.06
21.	1.51	1.55	1.50	1.46	1.18	1.38	1.38	1.58	1.38	1.35	1.42	1.48	1.59	1.19	1.12	1.07	1.32	1.22	1.27	1.64	xxx	.56	.02	.02	.07	−.12	.08	−.03	−.06	−.07	−.05
22.	1.31	1.39	1.34	1.30	1.02	1.17	1.21	1.43	1.23	1.29	1.23	1.31	1.48	1.01	1.03	0.94	1.23	1.13	1.14	1.63	0.78	xxx	−.03	−.01	.03	−.12	.04	.11	−.03	−.06	.07
23.	1.55	1.46	1.37	1.40	1.40	1.50	1.58	1.72	1.53	1.55	1.57	1.54	1.46	1.42	1.40	1.35	1.50	1.43	1.48	1.58	1.42	1.35	xxx	−.17	−.27	−.05	.07	.09	−.08	−.10	−.06
24.	1.52	1.63	1.54	1.53	1.18	1.12	1.28	1.43	1.08	1.22	1.12	1.39	1.63	1.09	1.06	1.12	1.38	1.29	1.39	1.76	1.25	1.14	1.55	xxx	.76	−.21	.21	.15	−.23	−.22	−.01
25.	1.68	1.67	1.59	1.60	1.16	1.29	1.38	1.50	1.23	1.33	1.23	1.48	1.80	1.09	1.08	1.08	1.35	1.33	1.37	1.75	1.26	1.16	1.65	0.63	xxx	−.27	.26	.11	−.07	−.07	.06
26.	2.27	2.11	2.06	2.12	1.95	2.10	2.05	2.08	1.98	1.95	2.07	1.83	2.14	1.84	1.88	1.88	2.11	2.03	2.05	2.26	2.04	1.95	2.12	2.10	2.19	xxx	−.04	−.16	.18	.16	−.16
27.	1.49	1.45	1.40	1.40	0.94	1.11	1.29	1.41	1.19	1.28	1.23	1.38	1.58	0.95	1.04	0.93	1.34	1.26	1.22	1.56	1.14	1.02	1.31	1.02	1.03	1.91	xxx	.08	−.04	−.10	.11
28.	1.47	1.39	1.27	1.29	0.97	1.21	1.21	1.42	0.96	1.02	0.99	1.11	1.41	0.93	0.98	0.90	1.27	1.17	1.23	1.55	1.13	0.91	1.25	1.01	1.07	1.93	0.94	xxx	−.03	−.04	.16
29.	1.73	1.54	1.51	1.54	1.21	1.46	1.50	1.55	1.48	1.50	1.49	1.48	1.84	1.34	1.32	1.31	1.50	1.46	1.41	1.67	1.41	1.27	1.54	1.50	1.44	1.86	1.30	1.23	xxx	.97	.03
30.	1.68	1.49	1.47	1.52	1.19	1.43	1.51	1.52	1.44	1.48	1.46	1.49	1.81	1.32	1.31	1.28	1.48	1.43	1.41	1.66	1.40	1.26	1.54	1.47	1.42	1.86	1.31	1.20	0.25	xxx	.01
31.	1.48	1.31	1.29	1.30	0.99	1.05	1.21	1.45	1.11	1.19	1.11	1.26	1.34	1.07	1.01	0.98	1.38	1.30	1.35	1.62	1.21	1.00	1.40	1.15	1.16	1.99	0.99	0.90	1.26	1.24	xxx